Science & Mechanics

Complete

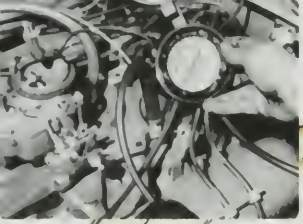
HANDYMAN ENCYCLOPEDIA

20

VACUUM CLEANER
WILDLIFE

do-it-yourself

Complete
Handyman
do-it-yourself
Encyclopedia



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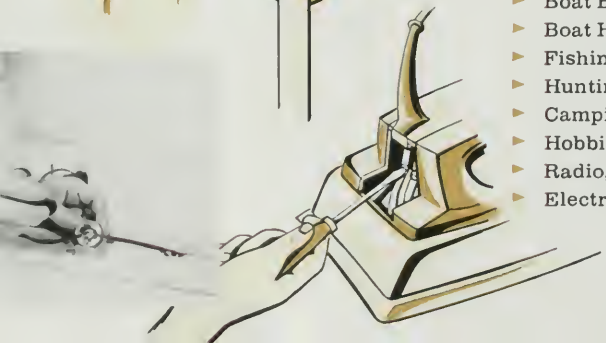

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- Auto Repair and Maintenance
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Complete Handyman yourself Encyclopedia

A COMPILATION OF NEW AND PREVIOUSLY PUBLISHED SPECIAL INTEREST PROJECTS AND MANUALS FOR THE REPAIR AND CARE OF HOMES, AUTO, APPLIANCES, HOBBY EQUIPMENT.

by the editors of

Science & Mechanics

20

VACUUM CLEANER
WILDLIFE

H. S. STUTTMAN CO., INC. *publishers* Westport, CT. 06889

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ISBN 0-87475-700-2
Library of Congress Catalog Card No. 74-21375

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PRINTED IN THE UNITED STATES OF AMERICA

13P(026)125-396

VOLUME 20

VACUUM CLEANER

HOW TO REPAIR YOUR VACUUM CLEANER: You can save on repair bills by repairing this busy appliance yourself 2933

VACUUM GAUGE

PINPOINTING ENGINE AILMENTS WITH A VACUUM GAUGE: If you know how to read the needle, you can identify more than 30 powerplant troubles, as well as measure your engine's overall efficiency quickly 2937

VALVES

HOW TO DO AN ENGINE VALVE AND RING JOB: This is a big job, but with some help from a jobber and a machine shop, you can do it yourself 2943

ADJUSTING VALVES FOR MAXIMUM ENGINE PERFORMANCE: You get a bonus in power from mechanical valve lifters, but only if you give them the attention they require 2953

VANITY

MAKE A THEATRICAL VANITY MIRROR: Putting on make-up is a pleasure with this easy to build, softly illuminated, theatrical mirror 2957

COMBINATION VANITY TABLE AND WRITING DESK: With the middle drawer replaced by a swing-up mirror and cosmetics tray, this handsome table can serve two different purposes 2960

VENTILATION

HOW TO VENTILATE WITH KITCHEN AND BATHROOM FANS: These blowers can make your house a more pleasant, and possibly healthier, place to live 2965

WAFFLE IRON/GRILL

HOW TO REPAIR WAFFLE IRONS AND GRILLS: These devices are extremely simple and there is very little that can go wrong with them beyond a frayed cord and stuck thermostat 2974

WAGON

BUILD A PATIO FLOWER WAGON: This interesting wagon-like device is designed to be used as an outdoor planter 2979

WALKIE-TALKIE

WALKIE-TALKIE REPAIR: These easy-to-do procedures heal most walkie-talkie ailments 2980

WALLBOARD

HOW TO INSTALL GYPSUM PANEL WALLS: This inexpensive material offers the same smooth, continuous surface as a plastered wall, and it can be installed by any home do-it-yourselfer of average skill 2984

WALL COVERINGS

HOW TO PREPARE WALLS FOR PAPERING: If you want a wall covering that is free of cracks, bulges, wrinkles or loose spots, you must hang it on a smooth, clean surface 2993

HOW TO HANG WALL COVERINGS: Modern wallpapers are easy to apply and they can do much to establish the mood and character of a room 2996

USING IMITATION STONE WALL COVERINGS: You can apply a good looking imitation stone or brick covering to any wall, or section of a wall, in your house without the high cost of the real thing 3002

WALL DECORATIONS

WALL AND COUNTER DECORATING IDEAS: No need to have a drab kitchen when there are an almost endless variety of materials—tile, vinyl wallpaper, plastic laminates and even paneling that looks like wallpaper—to work with 3004

WALL SWITCHES

HOW TO SELECT COMBINATION ELECTRICAL SWITCHES: There's a switch for every electrical purpose. Use this guide to find the switch that meets your wiring needs 3010

HOW TO USE SURFACE-MOUNTED ELECTRICAL WIRING: You can use this handy two-volt tape to install remote control switches for almost any household electrical device 3015

WASHER AND DRYER

HOW TO REPAIR YOUR AUTOMATIC WASHING MACHINE: Except for the gear box, you can repair or replace most of the parts yourself—with a big saving in expensive calls by the repairman 3018

HOW TO REPAIR YOUR CLOTHES DRYER: This is a relatively simple appliance and, except for the burner in a gas dryer, you can do most of the work yourself 3028

WATER SKIING

HOW TO PRACTICE WATER SKIING ON DRY LAND: You can familiarize yourself with the basic starting position for water skiing on the beach, or in your living room 3035

RATE YOUR ABILITY ON WATER SKIS: If you wish, you can get a rating of your ability as a water skier from a national water ski association 3038

TRICKS YOU CAN DO ON WATER SKIS: Any experienced water skier can learn to do these basic trick maneuvers, with a few spills and some practice 3043

HOW TO SLALOM ON A WATER SKI: Anyone who has learned the basics on two water skis can learn how to slalom on one ski 3048

HOW TO WATER SKI ON YOUR BARE FEET: If you can water ski on skis, you can do it on your bare feet. The secret lies in having a powerful towboat 3053

WEATHER

BE YOUR OWN WEATHERMAN: Nobody can beat the experts in making a general weather forecast for a large area over a period of time, but if you want to know what the weather will do this afternoon at a particular location, you can do a more accurate job yourself 3057

WEATHER-STRIPPING

KEEP YOUR HOUSE WARM WITH WEATHER-STRIPPING: No matter how carefully you've caulked your house, wintry winds will still discover a chink you missed, or one that cannot be caulked. Here's how to seal those remaining chilly drafts 3069

WILD FLOWERS

HOW TO IDENTIFY WILD FLOWERS: You can begin a fascinating and inexpensive hobby as a wild flower enthusiast, or even as a collector. But be careful about picking wild flowers, some species are in danger of extinction 3073

WILDLIFE

THE CAMPER'S GUIDE TO ANIMAL INTRUDERS: No matter how cute they look, those campground prowlers are still wild animals. Enjoy them, but treat them with respect. A raccoon can give you a nasty bite and "Smokey the Bear" can tear your arm off without even half trying 3077

RECOGNIZING ANIMAL TRACKS: How to read the tracks that animals leave in the snow, wet ground or heavy dust 3082

HOW TO MAKE CASTS OF ANIMAL TRACKS: This fascinating hobby is inexpensive and it can produce interesting plaques for your wall or to use as gifts 3085

How to Repair Your Vacuum Cleaner

You can save on repair bills by repairing this busy appliance yourself

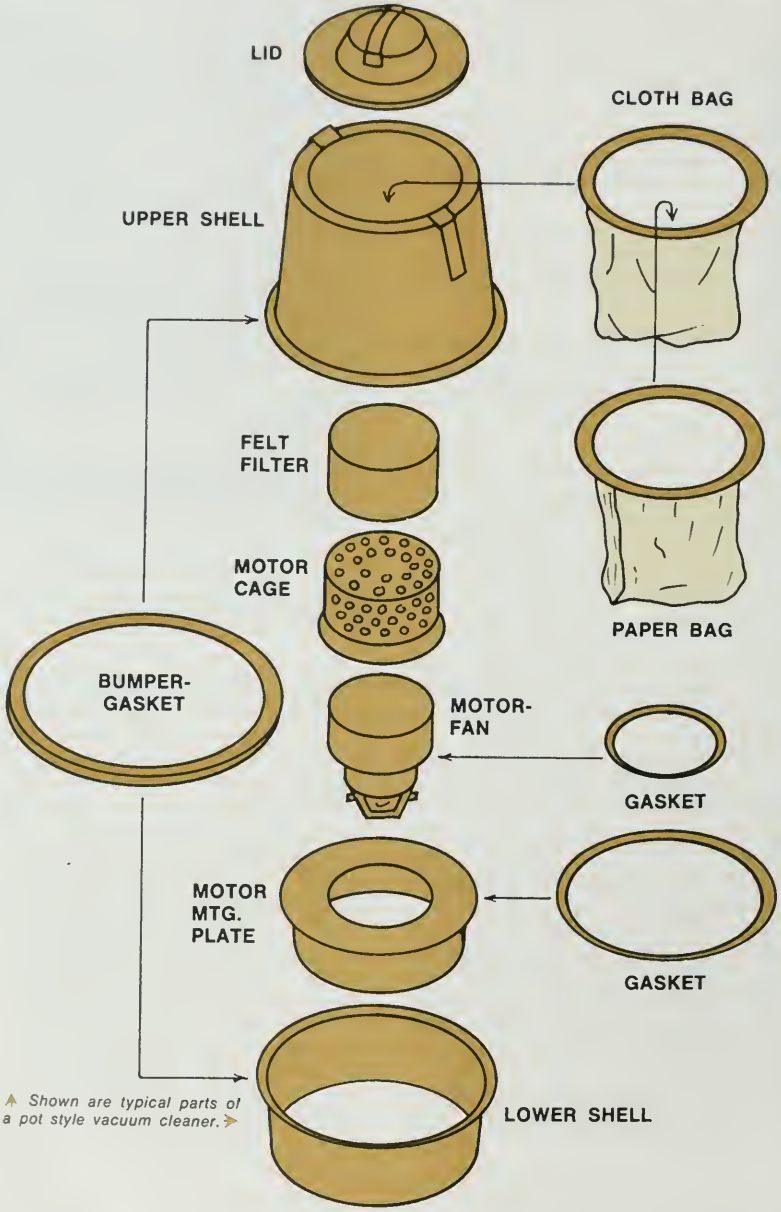
Popular pot style vacuum cleaner is basically of simple construction, easy to open and service. This home and institutional model came with a five year guarantee yet looks and works like new after seven years of hard use.

YOUR VACUUM CLEANER is a multi-functional appliance built to remove loose soil from just about anything in your home, including carpets, floors, walls, draperies, furniture and clothing. It can also be used as a blower to dislodge dust from such hard-to-reach places as behind radiators and piano interiors, to spray moth repellent or paint, and even to fluff and blow out allergenic dust from pillows. But your appliance can do these many necessary jobs only if it is maintained and operated properly.

When your vacuum cleaner fails to start, or stops suddenly while in use, check first to see if it is getting electrical power. The cord plug may have been pulled from the wall outlet, or the wall outlet itself may be dead because of an area power failure or because an overload on the branch circuit in your home has kicked the circuit breaker or blown a fuse. Test the wall outlet with a table lamp. If you have power, flip the on-off switch a few times and jiggle the switch handle while in the "on" position; this simple test will sometimes reveal a switch defect.

If the appliance is alive, but does not clean properly because the suction is not as strong as it should be, see if the hose is clogged by blowing a blast of air through it (out of doors!). Also check the dust bag which may be too full; the bag should be replaced when only about half full. Also make certain that all hose, wand, nozzle and hose-to-tank connections are tight.

If these preliminary tests do not cure the problem, it's time to take a look at the appliance's innards. A pot type vacuum cleaner is shown here, but the same general inspection procedure will apply to almost any style of appliance. First examine the housing carefully to find the bolts that hold the housing sections together. These will be on the bottom of the pot in some cases, or perhaps underneath a mid-level rubber bumper as in the example shown here. After the upper section of the housing has

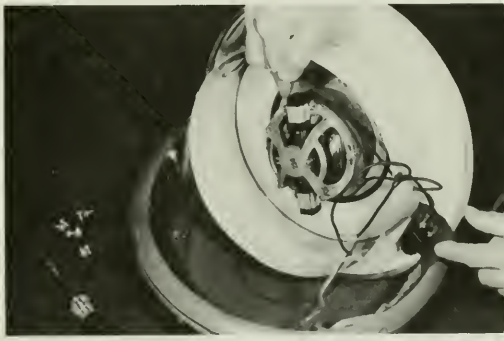


Shown are typical parts of a pot style vacuum cleaner.

been removed, you can probably just lift out the interior section to which the motor and fan unit is mounted. Be careful not to damage the gasket.

If you suspect that the trouble is in the on-off switch, first make sure that the coil spring controlling movement of the foot pad is in good condition, and not jamming the switch action. Next bridge the switch terminals with a short length of insulated wire while the power cord is plugged into a wall socket. If the appliance comes alive, you need a new switch. If the motor remains dead even when the switch is bridged, look for a defective power cord and check all connections between the switch and motor. Maybe a wire nut used to join the wires leading to the motor has vibrated loose and the connection has been broken. Check such connections with the power cord removed from the wall socket. The power cord itself may be defective. The easiest way to check this is by bridging the two conductors of the cord at some convenient points inside the appliance with a test light you can obtain at any hardware store (just a bulb with two short wires having exposed ends); if the bulb fails to light, you prob-

Coil spring around switch button, which controls action of the foot pedal, might be defective and cause poor switching action. Remove the perforated cage around motor/fan assembly only if it needs cleaning. Entire white section lifts out to reveal motor on the underside.



Two common sources of electrical problems are the motor brushes and the on-off switch. Also check wire connections between the switch and motor.

Shown here is a common operational fault. Dust bag should have been emptied or replaced when only half full to ensure proper suction and to provide adequate cooling air flow over the motor.

ably have a bad power cord. Another way is to short the two conductors inside the appliance and bridge the prongs of the power cord plug with a flashlight bulb and dry cell wired in series. Or an ohmmeter could be used in lieu of the bulb and cell; a high resistance reading indicates a broken conductor in the power cord.

If the motor operates, but in erratic fashion, pay special attention to the condition of the motor brushes and commutator. If the commutator is very dirty, polish it very carefully with very fine sandpaper; do *not* use emery cloth or steel wool. If the brushes are worn down so that they do not make firm contact, obtain new brushes of the same size. Sometimes the trouble derives from poor pressure springs, or corrosion on the wire contacts to the brushes, so check these before buying new brushes.

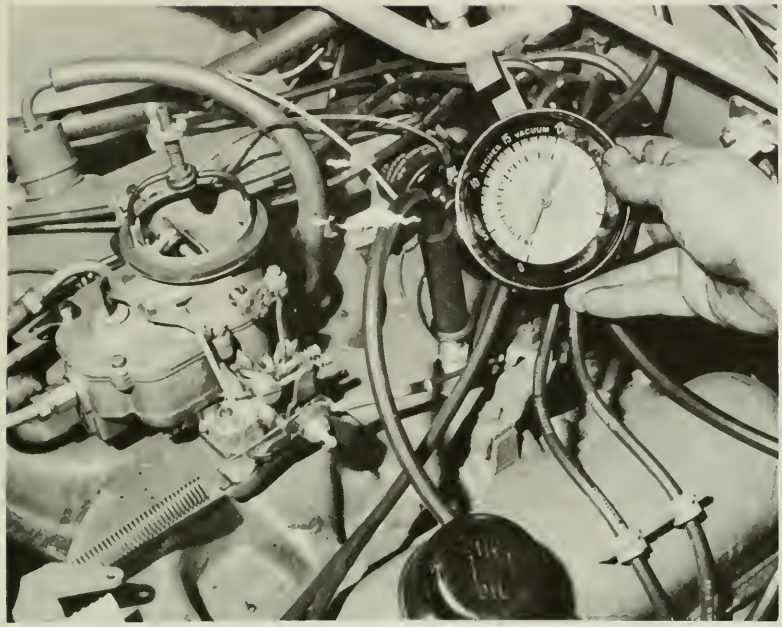
If the motor assembly seems very dirty—perhaps because a torn bag in the dust-collecting compartment lets dirt get through to the motor area—clean it thoroughly and apply lubricant sparingly to all moving shaft and bearing areas. And repair that torn dust bag! Such serious problems as a damaged or loose fan section, frozen bearings or bent armature shaft should be easy enough to spot. Electrical problems within the motor itself, for example a shorted motor coil or a grounded winding, may require professional attention.

When you reassemble the appliance, be sure that all gaskets are in good condition and that you fit them properly in place. Even a small leak here can result in noticeable reduction in cleaning efficiency. J.H.

See also: APPLIANCE REPAIR; ELECTRICITY; INDIVIDUAL APPLIANCE LISTINGS; WIRING, ELECTRICAL.

VACUUM CLEANER
TROUBLE-SHOOTING CHART

	DEFECTIVE CORD OR PLUG	DEFECTIVE SWITCH	MOTOR BURNED OUT	MOTOR BRUSHES AND/OR SPRINGS DEFECTIVE	MOTOR COMMUTATOR DIRTY	MOTOR ARMATURE BEARINGS FROZEN	CLOGGED HOSE AND/OR FULL DUST BAG	HOSE AND/OR NOZZLE IMPROPERLY CONNECTED	TANK GASKET SEALS DEFECTIVE OR LOOSE	MOTOR CAGE CLOGGED	AIR EXHAUST HOLES CLOGGED	SHORTED MOTOR COIL	MOTOR WINDINGS GROUNDED	MOTOR/FAN BEARINGS NEED LUBRICATION	ARMATURE BEARINGS WORN	ARMATURE SHAFT BENT	FAN BLADE BENT OR BROKEN
DOES NOT START	✓	✓	✓	✓	✓	✓											
NO SUCTION						✓	✓	✓	✓	✓	✓						
POOR SUCTION						✓	✓	✓	✓	✓	✓			✓			
OVERHEATS				✓	✓	✓	✓			✓	✓		✓	✓	✓	✓	✓
ERRATIC MOTOR ACTION		✓			✓							✓	✓	✓	✓		✓
NOISY OPERATION				✓										✓	✓		
SHOCK TO OPERATOR	✓																



Vacuum gauge can pinpoint many engine ailments.

Pinpointing Engine Ailments with a Vacuum Gauge

If you know how to read the needle, you can identify more than 30 powerplant troubles, as well as measure your engine's overall efficiency quickly

NATURE MAY ABHOR a vacuum, but the economy-minded motorist is all for it. He knows that high engine vacuum readings indicate superior driving efficiency, excellent engine performance, and more miles to the gallon. And he measures the vacuum of his car's engine with a vacuum gauge.

Showing you how to squeeze more mileage from a tankful of gas is not a vacuum gauge's only virtue, either. It's also a top-notch trouble-shooter—quick to diagnose over 30 engine ailments—all the way from sticking valves, bad carburetor adjustment, worn timing chain, leaky head gasket and clogged muffler, to rings in poor condition, loose valve guides and faulty cylinders.

You can obtain one of these "engine doctors" at moderate cost from auto accessory stores. It is installed by connecting it to the intake manifold. On cars equipped with a vacuum-operated windshield wiper, you remove the windshield wiper hose and attach

valve adjustment: see engine
valve repair: see faucets

the vacuum gauge hose. If the car has a vacuum-booster pump, take off the booster line at the manifold and plug the opening.

Unfortunately, very few cars have vacuum-operated windshield wipers. Electric wipers have been standard on virtually all cars for many years (some current American Motors cars are an exception).

On some cars with electric wipers, there is a plug in the intake manifold. Remove it and thread in the fitting normally supplied with the vacuum gauge. If the fitting is not the correct size, you can obtain another from most auto parts houses.

If there is no plug, you can obtain a T-shaped fitting from an auto parts house and install it in the hose to the power brake unit. Do not install the vacuum gauge T-fitting in the line to the distributor vacuum advance, although this would seem to be a logical place. On many cars, the location of the vacuum advance port is such that you will not get a true vacuum reading at engine idle.

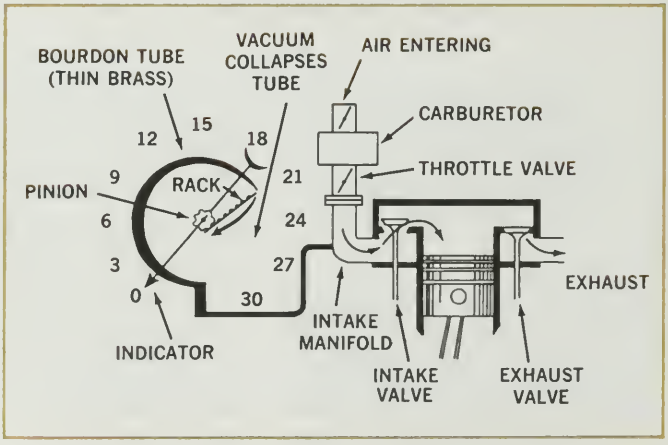
Reading a vacuum gauge. Many automobile engines in good condition show a steady vacuum reading somewhere between 17 and 22 as most gauges are calibrated.

Note: on some high-performance engines, the vacuum gauge reading may flicker slightly.

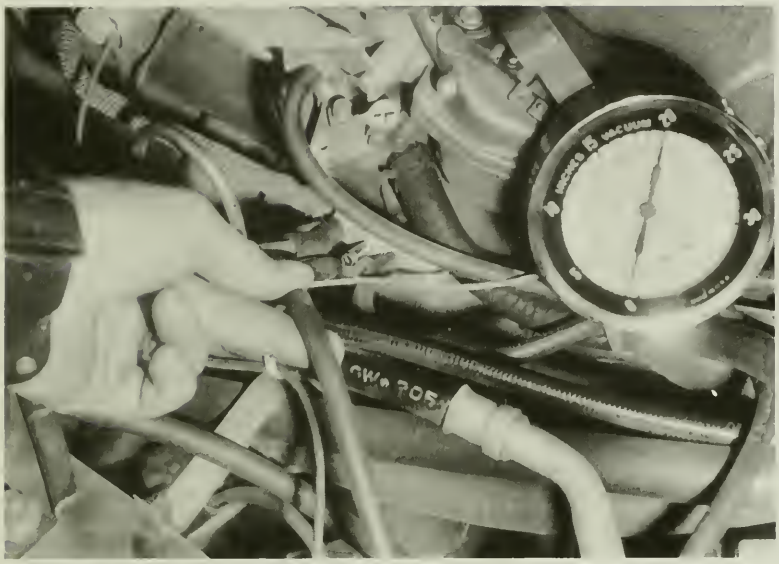
This reading will drop 1 point for each 1,000 feet that the car is above sea level. Technically, these points on the gauge are referred to as "inches of mercury." Originally, vacuum gauges were U-shaped glass tubes with mercury at the bottom of the U. The greater the vacuum, the higher the column of mercury. Measured in inches, the standard for vacuum reading became inches of mercury.

See the illustrations for some typical readings. The first is a steady reading showing 20 inches. But compare this with the next. Here the needle is slowly swinging back and forth on either side of 18. Something is making the engine speed up and slow down. This something is usually faulty carburetion, though the action may also be due to air leaks between the base of the carburetor and the manifold, or between the manifold and the engine block.

If such oscillation of the hand is noted, tighten the bolts that hold the carburetor to the manifold and those that hold the manifold to the block. Then turn the low-speed



Drawing shows how vacuum gauge works. Tip of Bourdon tube moves toward center as vacuum increases, moving rack, pinion and gauge hand. Opening throttle lowers vacuum reading; closing throttle increases it. Variation in piston speed causes gauge to pulsate. Air leaking into intake manifold, or compression pressure escaping into it, lowers gauge reading.



Finding a connection point for a vacuum gauge may be difficult. On this car, a multiple vacuum hose connector is the choice.

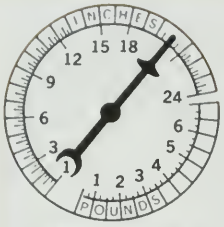
mixture, adjusting screws of the carburetor in (clockwise), possibly ¼ turn, until the vacuum gauge suddenly reduces its reading two or more divisions of the scale. Then turn the mixture screws out (counterclockwise) until the gauge reading reaches the highest obtainable value.

If the hand still continues to swing, then the carburetor may have a high float level, or the air cleaner may be clogged, or the fuel pump may have high pressure. Any of these conditions could give a rich mixture that would result in the oscillating gauge reading. If cleaning the air cleaner does not cure the trouble, try bending the carburetor float level down 1/16-inch and repeating the test. If no improvement is noted and the carburetor has gone 30,000 to 40,000 miles, try a new or rebuilt carburetor.

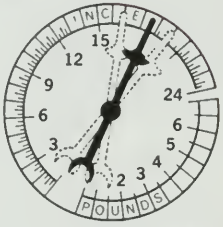
Note that the vacuum gauge hand in the third reading is steady, but at the low end of the acceptable range. This could happen on a new engine due to stiffness which necessitates extra throttle opening. Or it could happen on an engine that has not warmed up and is using heavy oil.

The reading in that illustration merely means that the throttle is opened wider—thus admitting more outside air—in order to keep the pistons moving. There are a number of possible causes for this wider throttle opening. It may be because of a new engine, or because valve and ignition timing are late as the result of worn timing gears or timing chain. Or, late ignition alone could cause this low gauge reading. Since the ignition is not efficient and full power is not delivered to the piston, the throttle must be opened farther to keep the engine running. And opening the throttle lowers the vacuum reading.

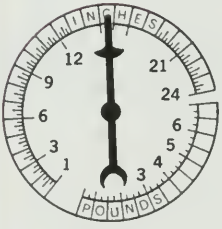
Greatest value of the gauge results when



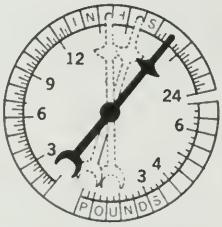
NORMAL VACUUM READING



A SLOW OSCILLATION



A LOW STEADY READING



A STEADY PULSATION

you check your engine vacuum from time to time. Then if you find the vacuum reading reducing, you are on the trail of lost efficiency.

Finally, a totally dead cylinder, blown head gasket, burned distributor contact points, or a leaking intake valve could cause the considerable pulsation at a steady rate indicated in the final reading.

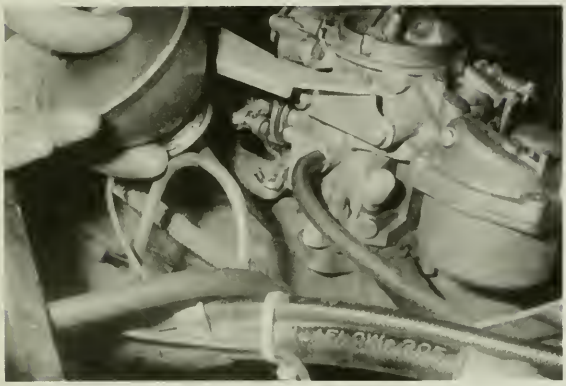
Understandably, these vacuum gauge indications become even more valuable when followed by compression tests. When you have a condition such as that indicated by the vacuum gauge in the final reading, a compression reading would show whether or not the trouble was due to faulty valves.

Experienced users of the vacuum gauge do more than just watch the reading at low idle, however. If the reading is a little low, the operator will open and close the throttle suddenly. If the gauge drops to zero and then shoots up between 20 and 22 when this is done, the chances are that the engine needs new rings. A compression test should follow in order to check whether this is the case or not.

If the reading is quite low—between 10 and 15—loosen the clamp on the ignition distributor. Turn the distributor against the ignition cam rotation while watching the gauge. Turning the distributor housing against distribution shaft rotation advances the spark. If this brings the vacuum reading up one or two or more points, it is a sure indication that the car has been running with a retarded spark. Since wear of the fiber block on the moving arm in the distributor retards the spark, check the condition of the distributor contact points and either adjust them or put in new ones.

Bleeding air. On old cars, you will often find air bleeding into the intake manifold through a worn carburetor throttle shaft.

Some vacuum gauge indications. Text explains what they mean.



Squirt a little gas at base of carburetor. If this increases vacuum reading, it indicates leaking carburetor gasket.

Air may also get in if the carburetor gasket is broken, or if the carburetor is loose on the manifold. A quick check for these conditions is made by some mechanics by placing a small quantity of gasoline in an oil can and, with the engine idling—and being careful of the fire hazard involved—applying a drop of gasoline at each end of the carburetor throttle shaft. If this causes the vacuum gauge reading to vary at all, it means that the gasoline is being drawn into the engine.

Make the same kind of test at the base of the carburetor to see if air is being sucked in at the gaskets. The same check can also be made by dripping gasoline at the exposed edge of each manifold-to-engine gasket.

If any of these other tests show an air leak as indicated by the gauge reading varying from one to five points, tighten the part or replace the gasket.

Spark plug gaps are often set up to .005-inch wider than specifications call for to give smooth idling and quick starting. Smooth idling from any cause gives a steady vacuum gauge reading. Spark plug gaps are also often set .003 to .005-inch closer than specifications call for in order to gain greater top speed. Some individuals may overdo these variations from specifications. If the vacuum gauge oscillates over a range of one or two points, it may be because spark plugs are set too close. If you get such a swing on your car, check the spark plug gaps and set them properly to specifications.

When cars overheat or fail to reach expected road speed, you may have a restricted exhaust system from carbon in the exhaust pipe or muffler, or a bent or clogged tail pipe. To test this, run the engine at about 2,000 rpm. This would be about what would give the car 40-50 mph on the road. If the vacuum gauge reading reduces gradually from a normal value of between 17 and 22 to almost zero, and then begins to climb slowly, you may be sure that the exhaust system is offering excessive resistance and should be checked.

Power balance test. If, because of low or irregular vacuum gauge readings, you suspect that a cylinder is faulty, how can you tell which one it is? The answer is that you make a power balance test, by shorting out certain groups of spark plugs and noting the effect on the gauge reading.

Note: cars equipped with exhaust gas recirculation (EGR) will not give meaningful results unless EGR system is discon-

nected. Certain Chrysler products have an internal EGR system and on these, the power balance test is impractical.

For an efficient power balance test, regular automotive trouble-shooters often use as many as six ground wires attached to a common ground clamp. To avoid electrical shock, attach the common ground clip from the grounding wires to the engine first. Then attach the wires to the spark plugs.

In order to attach these wires (which are made from ordinary spark plug wire) to the spark plugs, you will need special adapters, which are available from auto parts houses.

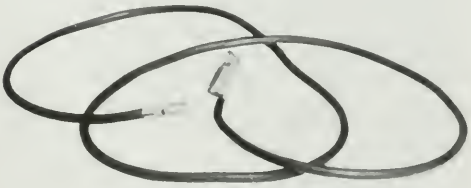
The adapters provide a clip-on point for the grounding wires, which normally are fitted with alligator clips. Without these adapters, the plug wire terminal would cover the plug terminal and there would be no way to attach the grounding wires.

The idea of the balance test is to short out all but a pair of companion cylinders. These are the cylinders whose pistons are in the same position at all times, but on different strokes.

When one piston is going down on the intake stroke, the companion is going down on power stroke. When one is coming up on compression stroke, the other is coming up on exhaust.

To determine the companion cylinders, you must know the firing order of the cylinders and how they are numbered.

The firing order for all in-line six-cylinder engines is the same: 1-5-3-6-2-4, and the cylinders are numbered 1-2-3-4-5-6, starting from the front. V-8s vary all over the lot, and we suggest you ask the counterman where you buy your auto parts.



▲ *Homemade grounding wire for power balance testing.*

To pair off the companions, take the firing order and divide it in half. Place the second half under the first half, and the companions are the cylinders directly above and below.

Examples: six-cylinder in-line 1-5-3
6-2-4

companions are 1 and 6, 5 and 2, 3 and 4.

V-8 with firing order 1-8-4-3-6-5-7-2

1-8-4-3
6-5-7-2

With the grounding wires, short out all cylinders but one companion pair and run the engine on the pair with a tachometer and vacuum gauge connected, and the engine warmed up.

Note engine speed and vacuum gauge reading.

Do the same for the other companion pairs.

If, on this power balance test, the vacuum gauge shows a variation greater than one inch between pairs of cylinders being tested, these cylinders are off balance. (If you used a tachometer, the speed variation should be no greater than 40 rpm between pairs of cylinders being tested.) To isolate *one* weak cylinder, short out half of the cylinders in an in-line engine, or an entire bank in a V engine. The bank that gives the lower vacuum gauge reading includes the weak cylinder.

These, then, are some of the more important of the many applications of the vacuum gauge. It can save you money; it can give you the satisfaction of having a smooth-running efficient car. Unfortunately, it can't remedy the faults it finds. But it can and does simplify that job tremendously. P.W.

See also: CARBURETORS; ENGINE; IGNITION SYSTEM, AUTO; PARTS REPLACEMENT, ENGINE; SPARK PLUG; TUNE-UP, ENGINE; VALVES.

How to Do an Engine Valve and Ring Job

This is a big job, but with some help from a jobber and a machine shop, you can do it yourself

THIS ARTICLE IS LIMITED to overhead valve engines, which represent the overwhelming majority of engines in cars on the American road. There are a few foreign and domestic cars with overhead camshaft engines. Such engines require special handling and/or tools to maintain or restore the relationship between the crankshaft and the camshaft. Clearly, when the cylinder head on an overhead camshaft engine is removed, the camshaft comes with it. Because of the special complexities, do not attempt this work on overhead camshaft engines unless you have a factory shop manual and considerable experience.

If your engine pressure readings indicate trouble, you probably have a valve or piston ring job in the planning stages.

The first step is to isolate the problem. Squirt oil into a cylinder and take a compression reading. The oil will temporarily seal off the piston-to-bore clearance, so if compression readings rise to near normal, the problem is in the valves.

If the readings do not rise significantly, the compression loss is because of worn rings.

In either case, you must remove the cylinder head (the procedure is the one you must follow to replace a cylinder head gasket).

The valves. Before removing the cylinder head, or heads, drain the water, remove the water hose if it is an in-line engine, and remove any other accessories fastened to the head or valve covers.

Next, remove the intake manifold. You'll have to disconnect the fuel line and the carburetor throttle linkage and take off a few hoses.

Normally the exhaust manifold can either be disconnected at the exhaust pipe and

pulled with the cylinder head, or disconnected at the cylinder head and pulled away from it, permitting you to lift the head out.

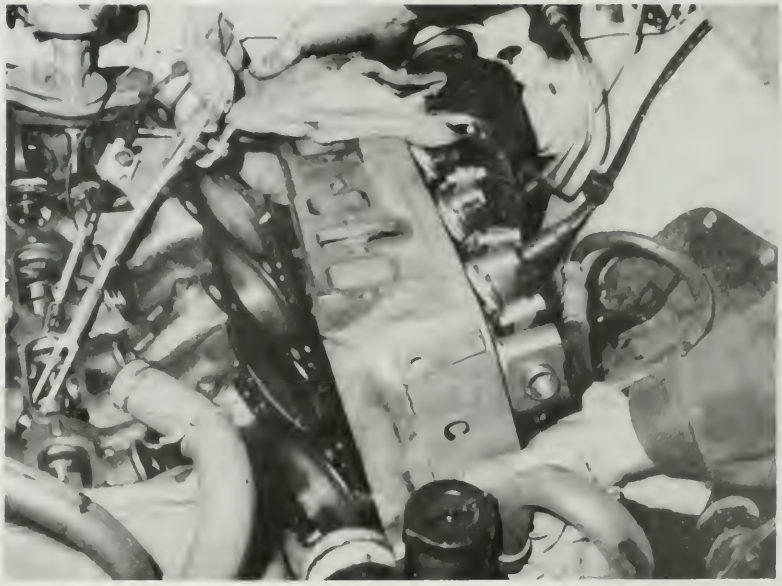
Next, remove the pushrods, and if you wish, also the rocker arm assemblies. If the engine has ball-socket rocker arms, they are simply loosened and turned aside where necessary to reach the head bolts. A ratchet and socket on an extension are used to loosen the head bolts. After all bolts are removed, the head should lift off easily. If it sticks, bump it with a mallet, but do not pry between the head and block with a screwdriver. Lay the head, or heads, aside and clean the piston tops by turning the engine to bring them to the top of the block. Scrape off the carbon and clean off any gasket cement you notice on the block.

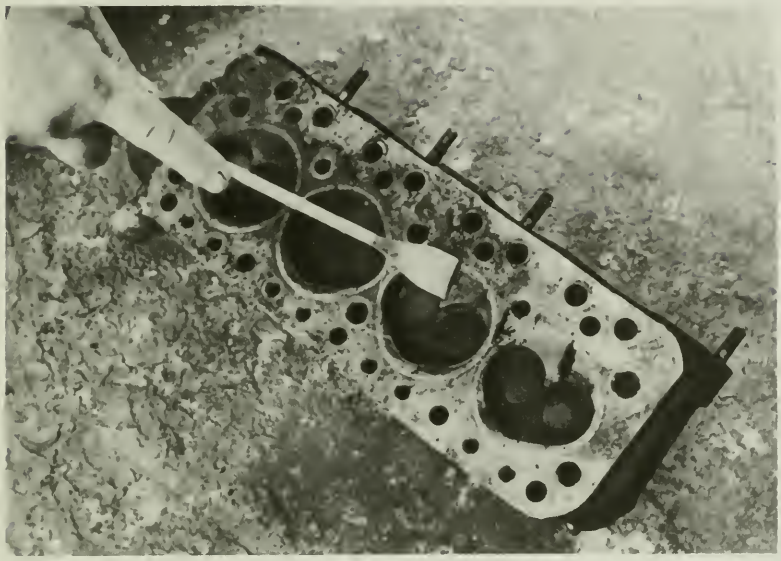
Take the complete head assembly or assemblies into a jobber's. He disassembles the head, cleans it, faces the valves, and seats and reassembles the head. A jobber can do the valve job so much quicker than you that his price is well worth it. A big C-shaped spring compressor quickly pops out the valve keepers and the valves are removed, the head or heads are degreased and checked to see that they are true on the gasket face, and, if it is necessary, the face of the head is milled to true it up.

Stems, seals and springs. If you determined that the valve guides were allowing a lot of oil to be wasted, the jobber can now modify the upper ends of the valve guides to permit the installation of premium oil seals to prevent oil leakage past the stem of the valve.

While the heads are in the jobber's shop,

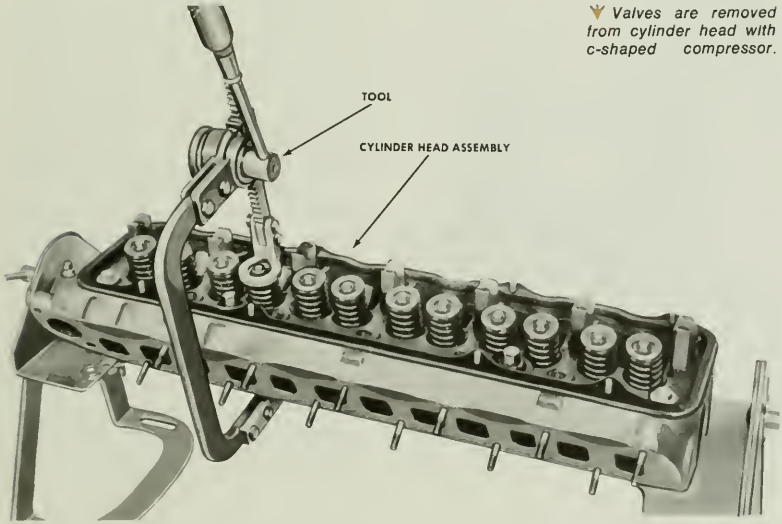
Cylinder head is pulled with pushrods removed and rocker shaft left in place.

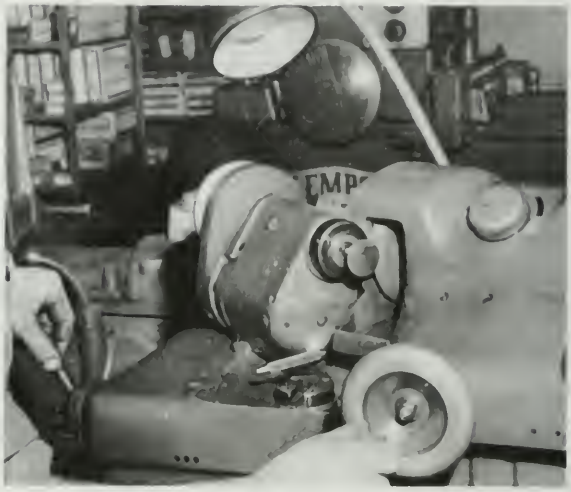




▲ *Scrape off carbon from tops of pistons, and gasket residue from block and cylinder head (as shown), using gasket scraper.*

▼ *Valves are removed from cylinder head with c-shaped compressor.*





Valves are refaced on special machine. Liquid coolant may be poured over valve during this operation.

the valve springs can be tested to see if they have the correct pressure, and that there is no great variation between the pressures in the set. The jobber slips each spring into a tester that permits it to be compressed a definite amount, to a certain length. A table furnished by the manufacturer gives the specifications that the valve springs from any particular engine should meet. Correct springs are available from the jobber to replace any springs that do not meet specifications.

The valve guides are cleaned with a wire brush spun by a drill. If they are excessively worn, they are pressed out and new ones are installed. The valve seats are recut with a special grinding stone that is positioned precisely by pilots that fit into the guides.

The valves themselves are refaced on a machine that rotates them against a rotating stone, while a liquid coolant is pumped over the valve. Many conscientious jobbers check the valves for fit and hand lap them with grinding compound if necessary, for accurate seating.

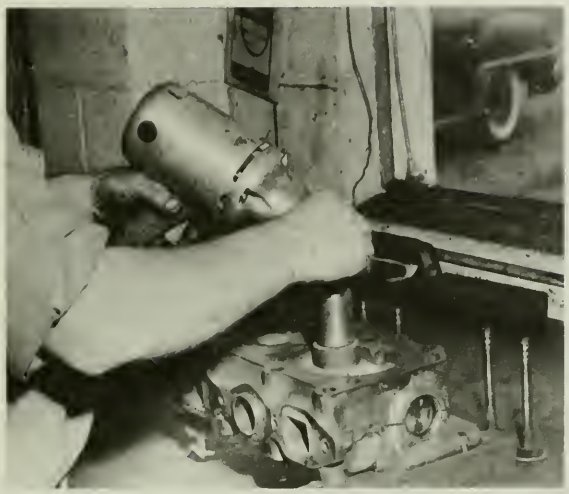
The jobber will reassemble your overhead valve head, so all you have to do is reinstall it.

Tightening down the cylinder head does require a torque wrench.

Adjustment. After all the valves have been installed, loosen the rocker arms so each valve is loose and the lifter can be moved slightly up and down when the valve is seated. Using a feeler gauge, set all the exhaust valves .002-inch wider than the hot specifications (if a hot setting is specified) and .001-inch wider for the intake valves. After the head and accessories are reinstalled, start the engine and warm it. Presetting when cold will result in only a few of the tappets requiring a resetting when hot.

The above information is for a solid lifter engine. If your engine has hydraulic tappets, tappet clearance usually is zero spacing. To be sure of this, as well as other specifications in your engine, always use the service manual for your model automobile.

The ring job. Before plunging into a



Valve seats are refaced with special grinding stones to precise angles.

ring job, remove the accessory system parts that will interfere with the job. Then, the head, or heads in the case of a V-8, must come off, the oil pan must be removed, connecting rod caps taken off and the pistons slipped out from the top of the cylinder block. In all probability you'll have to remove the "ridge" which occurs at the top of the cylinder bore. The ridge is caused by the wearing action of the upper edge of the top piston ring and is fairly sharp. In many cases you cannot slip the piston out because the ring catches on the ridge and there is danger of breaking the piston or ring lands.

The lands also may be sprung so that you will have trouble installing new rings. Here is where you should get help from a shop man who has a ridge reamer. This tool reams or cuts away the ridge left by the old rings. The job should be done while the pistons are still in the bores, and you probably can rent a reamer from an automotive machine shop, but if you have a shop man come to your garage to do the job for you, he probably can also "mike" the cylinders for taper and out-of-round wear and run a hone in the cylinder bores to break the glaze to make a better seat for the new rings.

Valve spring tension is checked on special rig with torque wrench. Manufacturers supply spring tension specifications.

Start by draining the cooling system, and the engine oil from the crankcase. Then, using a socket wrench with a ratchet remove the cylinder head stud nuts or bolts, and lift the head.

Note the tops of the pistons. There may be an arrow or mark, such as the "dimple" on the piston denoting which way the pistons are installed. If there is no mark, make one with a sharp center punch so you can reinstall them correctly. If you see any strange marks on the heads of the pistons, a valve has been hitting the piston head. This could have been caused by a broken valve spring, or one that is weak, or by someone having the cylinder heads milled to raise the compression ratio, and overdoing it. In some cases there would be a clatter that could be heard when the engine was running.

Connecting rods. To remove the oil pan, jack up the car and put a couple of supports under the front end to give yourself more room to work. Be sure the supports are sturdy.

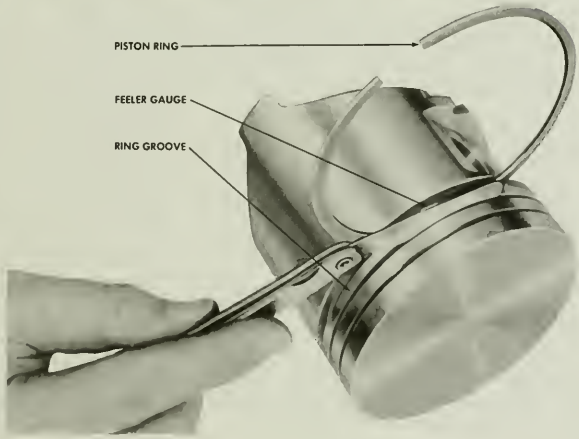
The actual removal of the oil pan is not necessarily simple. It is true that on some cars all you have to do is remove the screws that hold it and lower away. On other cars, you may have to remove a front crossmember. If the suspension is bolted to this crossmember, leave the work to a professional. In many cases, the engine mounts have to be disconnected and the engine must be jacked up several inches. Again, this is for the professional.

If your car is one of the simple oil pan types, however, go ahead and drop the pan.

When the oil pan is off, you will find some of the connecting rods in a position where you can remove the cotters or other "locks" on the nuts. Remove the caps of these rods and mark them (if they are not already marked), so that you will know from which rod the cap was removed and in what position it was on the rod. On an in-line engine, the rods usually have marks on the rod and cap on the camshaft side of the engine. If you can, have a helper handy to turn the engine crankshaft slowly with the fan belt so the other rods can be brought into position for removal.

➤ *Valve guides must be measured for wear. This split ball gauge is often used. Gauge adjusts for width until it is a tight fit in guide, then its diameter is measured. If guide is worn, it must be replaced. If guide is good, it can be cleaned with a reamer.*

▲ *Piston (without rings) also must have adequate clearance in its bore. This is checked by pushing piston with appropriate feeler gauge into bore (piston upside down), as shown.*



➤ *Piston ring clearance in groove must meet specifications. Clearance is measured with feeler gauge, as shown.*

Gather up the connecting rod caps and place them in proper sequence on a bench or board. Then rub the tips of your fingers up and down the cylinder bores at the top to determine if you are confronted with a ridge removal job. (Odds are that you will be.)

If you feel a ridge, get the shop man and tell him to bring along a dial gauge, inside micrometer and cylinder hone. After he removes the ridge at the top of the bores, the pistons and rod assemblies can be pushed out of the block. Then the shop man can check each cylinder for taper and out-of-round condition. Many piston ring manufacturers say that where cylinders are not to be rebored, the glaze at least should be removed to let the new rings seat. The shop man will use a spring-loaded hone for this. He may also tell you what rings to use, depending on what his cylinder measurements show.

Variety of rings. The ring makers have done a good job in producing various kinds of rings to meet cylinders with considerable wear. For example, if the taper or out-of-round wear is around .002 to .003-inch, practically any of the standard rings will do a good job. However, if it ranges between .004 and .008-inch, you can get piston rings supported with expanders that will do the work. In any event, you will have the shop man's measurements and any automotive supplier or jobber will recommend the specific rings you should use.

To remove the old rings from the pistons, mechanics use a special tool called a ring spreader, but in its absence you can do it by cutting four strips of thin sheet metal about ⅜ x 3 inches. Slide these strips under the rings and work them around the piston until equally spaced. The rings will then be expanded so they can be pulled off the piston over the strips. Most mechanics simply pull the ring ends apart and break the rings. If you try this, use gloves, since the ring ends can puncture fingers.

The job of cleaning the pistons and their grooves is very important; the measurements for the new rings depend upon it. Also clean out the cylinder bores which have previously been conditioned with the hone.

Inspect the piston for cracks, broken lands or excessive wear of the ring grooves. Here again it will pay you to let the jobber size up the piston-ring groove. He may advise regrooving, a process that also increases the width. Fillers are now obtainable which you slip into the groove over the piston ring to take up the extra space resulting from regrooving.

Finally, while the jobber has the pistons, have him resize the piston skirt. There are various processes used for this, one of which is Nurlizing, which actually makes worn pistons practically as good as new at only a fraction of the cost of replacing them. The process gives a closer fit without scuffing or scoring, prevents piston slap which you might otherwise get even with new rings, and assures adequate piston lubrication.

Fitting the rings. Now comes the actual fitting of the rings to the pistons and cylinder bores. A common practice is to locate two compression rings and two oil rings above the pin. The rings must be fitted into the cylinders so that the rings pass the smallest part of the bore with enough end or gap clearance to prevent binding, but no more than enough.

Place the top compression ring of cylinder No. 1 into the cylinder and push it downward with the top of the piston to the unworn portion of the bore. By pushing it with the piston, it will be square in the bore. If your pistons are not flat, but angle or "pentroof" type, ask your parts house or machine shop to lend you a flathead piston of the correct size to make this test. With a feeler gauge, check the gap for end clearance of the ring according to the ring manufacturers' instructions that come with the rings.

If the specified feeler gauge will not pass through the gap, remove the ring and file it by pushing it back and forth across a flat, smooth-cut file held in a vise. Do this carefully so that the gap is not distorted, but is square top, bottom, front and back. Check the other rings for piston No. 1 in the same way. Now take the top ring of No. 1 piston and roll it around the groove to see that it is free. To make sure that the clearance between the ring and its groove is correct, refer to the instructions packed with the rings or look in your shop service manual for the specifications, and check with a feeler gauge. Then proceed with the other rings for the rest of the pistons.

To slip the new rings into their respective grooves, a tool called a piston-ring applier or expander is used. If you don't want to rent one, you can use the strips of metal which you previously used to slide off the old rings—only this time reverse the procedure.

Replacing pistons. You are now ready to reinstall the piston and rod assemblies in their respective cylinders. Be sure to install them in the same bore and position from which they were removed. Check the mark on top of the pistons. On a three-ring piston, arrange the rings so the gaps are 120° apart; on a four ring piston, 90° apart. Arrange them so that no ring gaps come directly in line with the pin.

Then, grasping the connecting rod of the piston, dunk the piston and rings in heavy oil and spread a film of oil around the bore of the cylinder. Then lower the piston-and-rod assembly into the cylinder, having compressed the rings into the grooves with a ring compressor. This compressor is inexpensive, but like the other tools used, you don't have to buy it; it can be rented or borrowed for the job. With the crankshaft turned so the journal for the cylinder is all the way down, push the piston-and-rod assembly down so the upper rod bearing contacts the journal. Have a helper under the car to guide the lower end of the connecting rod. The rod bolts may project and if they strike against the smooth surface of the journal, a gouge or nick could result that would chew up the bearing insert.

At this point you consider doing some work on the connecting rod bearings. It could very well be that some of the oil consumption was due to worn bearings, in which case the oil throw-off was too much for the oil rings to handle. You may give the new rings a much better chance by installing new bearing inserts in the connecting rods.

It is important, after tightening the connecting rod caps, to secure the nuts with cotters or other "locks." Some connecting rod nuts are "self-locking," having plastic inserts, or they are designed with an inside taper that automatically locks them in place. Especially for this latter type setup, a torque wrench should be used, each nut being tightened according to the manufacturer's specifications. Clean the oil pan thoroughly and reinstall it, using new gaskets and oil seals on the pan ends. Reinstall the cylinder heads and other parts using new gaskets, and refill the cooling system and oil pan to the required level.

After you have the job buttoned up, start the engine and run it at fast idle (1500 to 1800 rpm) for about 15 to 20 minutes or until the engine coolant is warm.

Drive the car easily for 50 to 100 miles, then seat the rings by taking the car out on a highway and doing about a dozen full-throttle accelerations from 35 to 55 mph (cruise at 35, full throttle to 55, drop back to 35 and cruise for a mile, then full throttle to 55, etc.).

Laborious break-in procedures over a thousand or more miles are out of date. Use a good quality multi-grade oil (an additive is unnecessary). P.W.

See also: BEARINGS; ENGINE; HAND TOOLS; OIL, ENGINE; PARTS REPLACEMENT, ENGINE; TUNE-UP, ENGINE; VACUUM GAUGE.

Adjusting Valves for Maximum Engine Performance

You get a bonus in power from mechanical valve lifters, but only if you give them the attention they require

SOLD MECHANICAL VALVE lifters will be with us as long as there are small engines that can't afford a power loss and owners of big V-8s that won't tolerate one.

Hydraulic self-adjusting lifters are nice, but don't provide as precise valve timing as the solids. The solids, on the other hand, do not compensate for minor valve train wear, and need adjustment at about 6,000-mile intervals, or the accuracy of the solid setup is lost.

With few exceptions (overhead cam engines), overhead valve trains all are adjustable at the rocker arm. (Ford once made a six-cylinder with self-adjusting solid lifters, but there are not many of that design.)

The rockers are adjustable in either of two ways: a self-locking hex-head screw, or a slotted screw and hex-head locknut.

Clearance between rocker arm and valve stem tip should be checked with a good feeler gauge. (Weekend mechanics will find the go-no go type gauge easiest to use.)

If, because of wear, intake valve clearance is excessive, valves will open late and close early. An insufficient amount of fuel mixture will get into the cylinders and they will develop less power.

If exhaust valve clearance is excessive, exhaust gases won't be adequately purged. This will limit (and contaminate) the fuel mixture that can get in, and again, less power results.

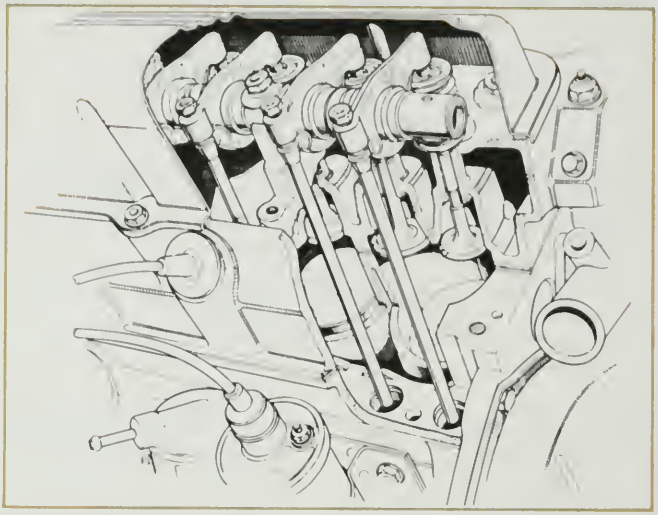
Too little clearance also creates problems. The valves open early and close late in this case, spending less time on their seats. The valves are cooled by transfer of heat to the seats, so if the clearance is inadequate, the valves will burn. Also, the incorrect timing of the valves will often cause rough idle and poor performance.

Always begin the job by tightening the cylinder head to specifications with a torque wrench. Tightening the head is a standard part of a major tune-up, and if it is done after the valve adjustment, the adjustment will be changed.

This is because the tightening of the head nuts or bolts compresses the head gasket, reducing the height of the engine.

Most American cars with solid lifters have the self-locking hex-head screw. Old timers may remember the slotted screw and hex-head locknut of American cars of years ago, and they will find this arrangement on most foreign cars.

Value clearance on cars with the self-locking hex-head screw is set with the engine fully warm and running at slow idle. The self-locking screw is easy to adjust.



This is an overhead valve engine with mechanical lifters that can be adjusted with the engine running. Note the self-locking nuts on the pushrod side of the rocker arms.

However, after an engine has a fair amount of mileage on it, the screw loses some of its self-locking ability and the valves require adjustment more often—perhaps twice a year.

Just slip the appropriate size feeler gauge (check manufacturer's specifications) between rocker and valve stem. If it won't fit in, turn the screw counterclockwise a bit until the gauge will fit. Then turn the screw clockwise until the feeler gauge can be moved in and out with moderate drag.

Don't confuse inability to withdraw the feeler momentarily with tightness. The engine is running and when the valve is open, the feeler is locked between rocker and valve stem. The moderate drag is for the instant that the valve is closed.

This means that the feeler should not alternate between being locked and slipping around. It either should be locked or be capable of being pulled out with moderate drag.

Note: The specified clearance for intake valves usually is different from the clearance for exhaust valves, so you should note the valve arrangement. The typical layout of intake and exhaust valves for a V-8 is E-I-I-E-E-I-I-E (each bank).

If the engine has the slotted screw and locknut, the valve should be adjusted with the engine off. Check to see if the clearance specifications are for engine hot or engine cold—the difference is important. Metal expands when hot and changes the clearances in the valve train.

Most imported cars have in-line engines so the valve arrangement is easy to see. The most popular import, however, is Volkswagen, and the valve arrangement on its pancake engine is not easy to see. It is E-I-I-E on each side.

To adjust valves with the engine off, you must make the adjustment with the piston at top dead center ("TDC") on the com-

pression stroke, for this is the time the intake and exhaust valves are closed and there is maximum clearance in the valve train. The manufacturer's clearance specifications are designed for this situation.

To determine when a piston is at TDC on compression, line up the timing marks. Either No. 1 cylinder or its companion in the firing order will be at TDC on compression (actually a few degrees before or after, but the marks will get you close enough).

To find out which piston is on compression, lift the distributor cap and see to which plug-wire insert the rotor points. Follow the spark plug wire from the distributor cap insert; it will go to the spark plug of the cylinder with the piston on TDC compression.

The valves of that cylinder are in position for adjustment—fully closed.

Try to insert the specified size feeler gauge between the valve stem and rocker. If it fits in and can be withdrawn only with moderate drag, it is in proper adjustment—leave it alone.

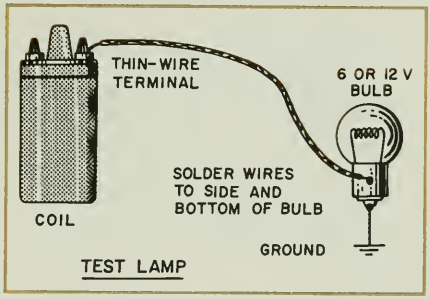
If there is insufficient or too much clearance for the gauge, slacken the locknut. Turn the adjusting screw counterclockwise to increase clearance, clockwise to reduce clearance.

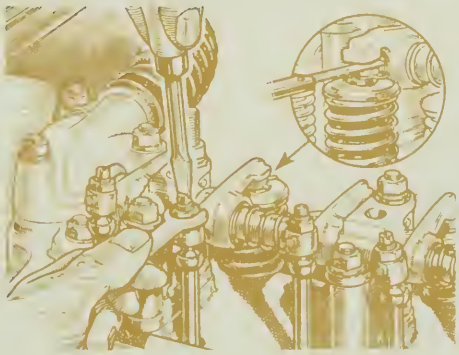
When there is just enough clearance between rocker and valve stem to produce moderate drag on the feeler gauge, tighten the locknut while holding the screw with a screwdriver.

After tightening the locknut, recheck clearance. If it has changed, you will then have to redo the adjustment.

When you have some experience, you will be able to set the clearance right the first time. One technique that often works is to set the clearance for light drag, hold slight counterclockwise pressure with the

Illustration shows how to make a test lamp. Lamp is connected to negative terminal (may be marked "CB" or with minus sign) of coil, and to ground.





Overhead valve clearance on many foreign engines is adjustable by slotted screw with locknut and measured between the valve stem and the rocker tip with a feeler gauge. It will be difficult to adjust if the rocker tip et the point in contact with the valve stem is worn.

screwdriver on the adjusting screw, and allow the tightening of the lock to pull the adjusting screw clockwise just enough to reduce clearance to moderate drag on the feeler gauge.

To set up the other valves for adjustment, connect a test lamp between the breaker points terminal of the coil and ground. Turn on the ignition and the test lamp will light.

Crank or turn the engine by hand (having the spark plugs out makes it easier). When the points close, the test lamp will go out.

When the distributor cam just cracks open the points, the test lamp will go on again, indicating that the ignition system is ready to fire another spark plug (in a cylinder that is on TDC compression).

Stop turning the engine the instant the test lamp goes on. The valves for the next cylinder in the firing order are ready for adjustment. If the firing order is 1-4-3-2 (for example, Volkswagen), and you adjusted No. 1, you would next adjust valves for No. 4 (then No. 3, then No. 2 cylinders). If the first set of valves adjusted was on No. 3 (the companion cylinder to No. 1 in a 1-4-3-2 firing order) you would next adjust No. 2 (then No. 1, then No. 4).

All manufacturers number their cylinders differently, so you should be familiar with the numbering system. (Most mechanic's specifications manuals give this information.) If you are not, you will have to see which plug wire the rotor points to, and follow it to the cylinder.

Note: on most cars, the adjustable screw is on the pushrod side of the rocker. On Volkswagen, however, it is on the valve stem side. This difference does not affect the adjustment procedure.

Many cars are equipped with overhead crankshaft engines. The imports in many cases have shim adjustments, which should be left to an import car mechanic. However, American cars have some form of adjusting screw, and because the camshaft is exposed, you can tell when a valve is closed, making the job quite easy.

The overhead-cam engine in the Chevrolet Vega has an Allen wrench hole in the side of the tappet for adjustment. Because of internal construction of the adjusting mechanism, the adjusting screw must be given a complete turn, which changes clearance by about .003-inch, or the adjustment won't hold.

Although this might make precise adjustment impossible, there is no problem. Chevrolet specifies an .002-inch range (.014 to .016-inch on intake valves; .029 to .031-inch on exhaust valves), engine cold.

The screw inside will lock in position when a complete turn is made. At that time, check clearance between tappet and valve stem.

See also: ENGINE; HAND TOOLS; PARTS REPLACEMENT, ENGINE; TUNE-UP, ENGINE.

Side-valve adjustments are made after removing the tappet cover on the side of the engine under the exhaust manifold. Measure between the valve stem and top-nut. Job is time-consuming; fortunately, side-valve engines are a rarity today.

Make a Theatrical Vanity Mirror

Putting on make-up is a pleasure with this easy to build, softly illuminated, theatrical mirror

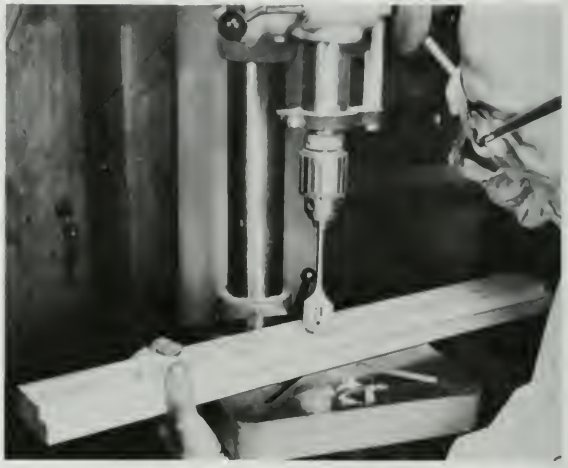
ONE OF THE WAYS you can make a theatrical vanity mirror is to use a large mirror that has a plain wood frame with sides at least 3½ inches wide, or you can use two vertical strips and set the mirror into a rabbet cut in the back.

Sockets used are a special type, only ¾-inch deep. They have a ¼-inch knurled porcelain cap that holds the socket in place. Size of the socket is 1¼ inches in diameter, with terminal screws on the back. These sockets are available at any electrical supply store, and are used with midget-base 15-watt frosted bulbs.

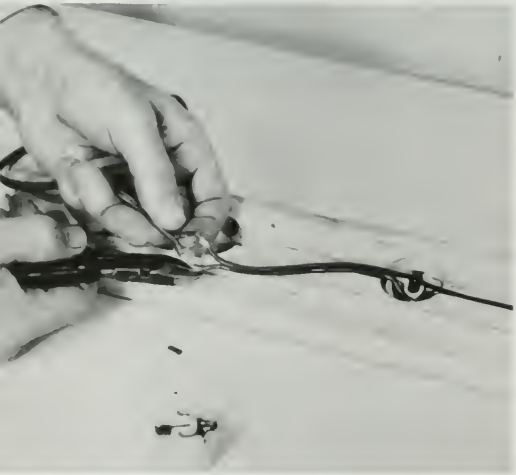
Make the frame by cutting the side pieces to 1 x 3½-inch. Length depends on individual requirements. Cut a ¼-inch rabbet on one edge of each frame piece. Mark off uniform spaces for the number of bulbs desired—holes were spaced 4 inches apart for the mirror shown.

After the frame pieces are shaped and socket openings marked, use a 1¼-inch bit to make the socket openings. Use the same

varnish: see floors
vegetable planting: see gardening
veining: see drill press
veneer application: see cabinets
veneer pictures: see inlay woodworking



▲ *Set drill gauge or depth stopper so the bit stops at least a 1/4-inch from the surface on each side frame.*



▲ *Use diagonal pliers to clip off insulation. Don't pull on plastic as it may go beyond desired length.*

▼ *Wind the bare wire on terminal screws and tighten down. Arrange the wire so it fits neatly in the socket.*

Apply adhesive tape to protect against contact with the terminals, and to keep the cord in groove.

After each socket is wired in place, turn the bar over and screw on the 5/8-inch porcelain lock caps.

center hole to make the 5/8-inch opening for the cap nut that is screwed onto the socket shell from the outside surface. Check the depth of the hole by test-assembling one of the sockets.

Cut a 1/4-inch groove in the back of the frame, through the center of the socket holes, so the lamp cord can be recessed.

Wire the sockets in series. Strip off about 1/2-inch of insulation from each wire, but do not cut the wire. Wrap the wire around each socket terminal, tighten the screws, and go on to the next terminals. At the bottom, add a button-type switch, then run the cord to a plug. Use adhesive tape to cover the cord and hold it firmly in place.

Assemble the mirror into the side rabbets, placing a 1/4-inch hardboard panel over the back so it overlaps the mirror by 1 inch. Attach the hardboard with a row of screws that are driven into the frame. A strip of 1-inch wide decorative molding across the top and bottom, attached to the hardboard with screws, will hold the mirror securely and make a solid frame.

As an alternative, these crossmembers can be mortised-and-tenoned into the vertical sides, or set into half-lap joints from the back for a more rigid construction. You can add a base, if the mirror is to stand on the vanity table.

See also: ELECTRICITY; WIRING, ELECTRICAL.

Combination Vanity Table and Writing Desk

With the middle drawer replaced by a swing-up mirror and cosmetics tray, this handsome table can serve two different purposes

HERE'S A CLASSIC VANITY table with built-in mirror, large drawers, and table-top cosmetic compartment.

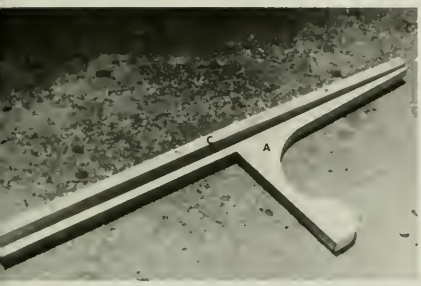
The vanity is made entirely of plywood, and it's the unfinished plywood edges that give an amateur look to many jobs. That's why wood edging tape comes in so handy. The plywood is ¾-inch stock with the veneer of your choice; birch is particularly attractive for this project.

Make up full-size patterns on kraft paper. Trace the outline of the leg pieces on the plywood, and cut these out. Always cut the pieces slightly oversize, and sand smooth for an exact, square fit at all joints. Note that both front and rear legs are made up of two pieces each. One Part C is glued and screwed to each leg as shown in the drawing. The edge with the exposed screw heads is then covered with wood tape.

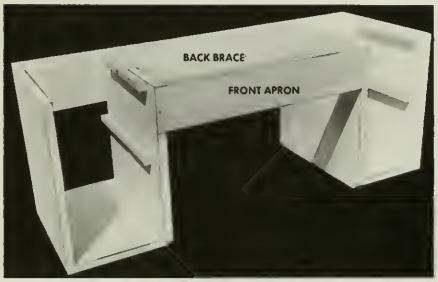
Cut out the back and side panels for each of the two cabinets, and the back brace and front apron. Carefully measure and mark the inside of each side panel, then install the pine drawer slides with glue and 3d finishing nails. Install pine cleats for the top in the same manner.

Use glue and 5d finishing nails to attach the two cabinet bottom panels to their respective sides. Set the nail heads below the surface of the wood, and cover with plastic wood. The back brace and front apron are attached in the same manner. The project at this stage is shown in a photograph.

Next add the four legs. They are attached with glue, and #8 flat head wood screws through the cabinet sides into the legs. The

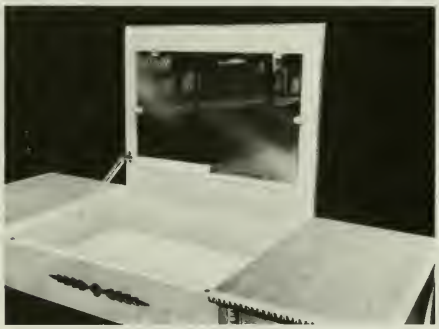


Use glue and screws to assemble both front and rear legs. Cover exposed plywood edge showing screw heads with wood trim.



Assembled cabinets are shown attached to front apron and back brace. Pine cleats for attaching tops are installed.

Vanity from rear. Note pine strip for piano hinge, plywood skirt attached to back brace and edges of cabinet sides.



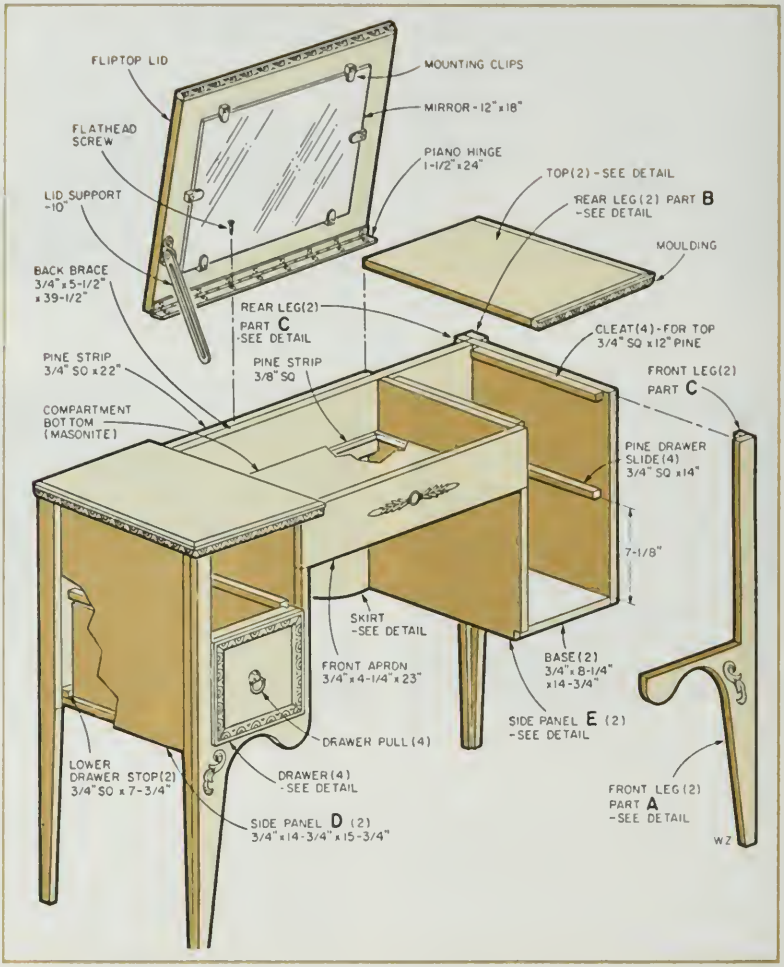
Shown are mirror and lid support which complete flip-flop lid. When the lid is down, vanity doubles as a writing desk.

scroll section of each front leg is attached to its cabinet base with glue and 5d finishing nails. Be sure to set the heads, and cover them with wood filler.

Use glue and screws to attach a ¾ x ¾ x 22-inch pine strip along the top edge of the back brace. Be sure the screws go through the plywood into the pine. This strip is for the piano hinge on the flip-top lid. Add pine strips around the bottom edge of the cosmetic compartment to support its bottom panel.

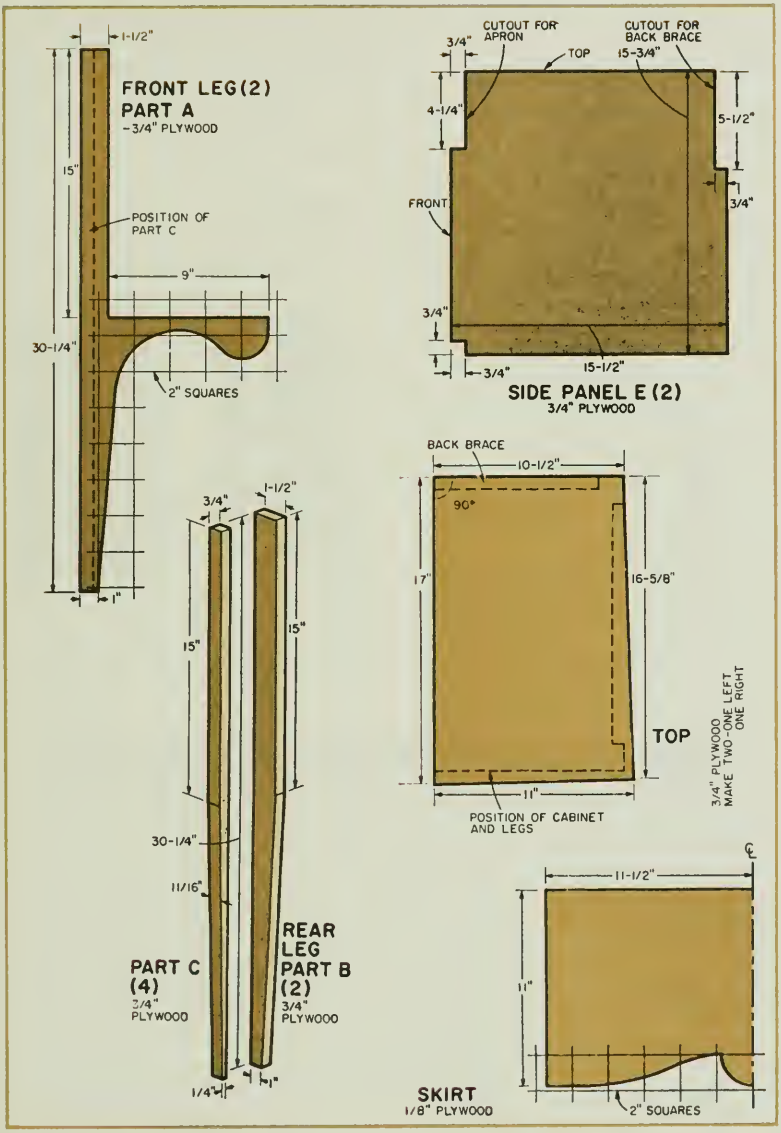
The two cabinet tops and the piano hinge can be installed, and flexible wood trim applied to all exposed plywood edges. This completes the basic assembly.

Make up the two drawers next. Be sure to cut a dado along the side edges of the two front pieces, and to groove the front and sides for the hardboard drawer bottoms. Coat mating surfaces with glue, and assemble with 5d nails. Drill one or two $\frac{1}{16}$-inch holes at the rear of each bottom panel, and run nails or screws through into the drawer backs to keep the bottom panels from sliding out of place.


FLIPTOP LID
MOUNTING CLIPS
MIRROR - 12" x 18"
FLATHEAD SCREW
PIANO HINGE 1-1/2" x 24"
TOP (2) - SEE DETAIL
REAR LEG (2) PART B - SEE DETAIL
LID SUPPORT - 10"
MOULDING
BACK BRACE 3/4" x 5-1/2" x 39-1/2"
REAR LEG (2) PART C - SEE DETAIL
CLEAT (4) - FOR TOP 3/4" SQ x 12" PINE
PINE STRIP 3/4" SQ x 22"
PINE STRIP 3/8" SQ
FRONT LEG (2) PART C
COMPARTMENT BOTTOM (MASONITE)
PINE DRAWER SLIDE (4) 3/4" SQ x 14"
7-1/8"
SKIRT - SEE DETAIL
FRONT APRON 3/4" x 4-1/4" x 23"
BASE (2) 3/4" x 8-1/4" x 14-3/4"
SIDE PANEL E (2) - SEE DETAIL
DRAWER PULL (4)
LOWER DRAWER STOP (2) 3/4" SQ x 7-3/4"
DRAWER (4) - SEE DETAIL
FRONT LEG (2) PART A - SEE DETAIL
SIDE PANEL D (2) 3/4" x 14-3/4" x 15-3/4"
WZ

Cut the cosmetic compartment bottom from hardboard and glue it in place. Cut out the back skirt from ⅛-inch plywood, and install it with glue and nails just beneath the back brace.

Finally, install the decorative wood trim, and drill for the drawer handles or knobs. Apply flexible wood trim around the exposed plywood edges of the front panels. Now the drawer fronts can be given the finish of your choice; while paint is suitable, a clear coating can also be used. In any


1-1/2"
FRONT LEG(2)
PART A
-3/4" PLYWOOD
15"
POSITION OF
PART C
9"
30-1/4"
2" SQUARES
1"
CUTOUT FOR
APRON
3/4"
TOP
CUTOUT FOR
BACK BRACE
15-3/4"
4-1/4"
5-1/2"
FRONT
3/4"
3/4"
3/4"
15-1/2"
SIDE PANEL E (2)
3/4" PLYWOOD
BACK BRACE
10-1/2"
90°
17"
16-5/8"
TOP
11"
POSITION OF CABINET
AND LEGS
3/4" PLYWOOD
MAKE TWO-ONE LEFT
ONE RIGHT
3/4"
1-1/2"
15"
15"
30-1/4"
11/16"
PART C
(4)
3/4"
PLYWOOD
REAR
LEG
PART B
(2)
3/4"
PLYWOOD
1/4"
1"
11-1/2"
11"
SKIRT
1/8" PLYWOOD
2" SQUARES

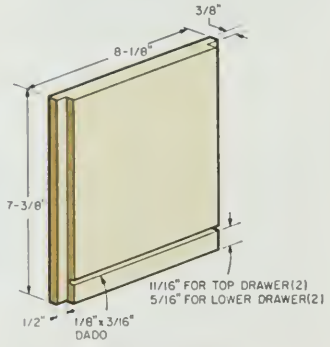
case, use at least two coats, and sand lightly between coats. When dry, the drawers are ready for their handles or knobs.

Cut out the flip-top lid, and install it to the piano hinge on the vanity. Next install the lid support, and mark the position for the mirror clamps; drill the pilot holes for the screws that go through these clamps.

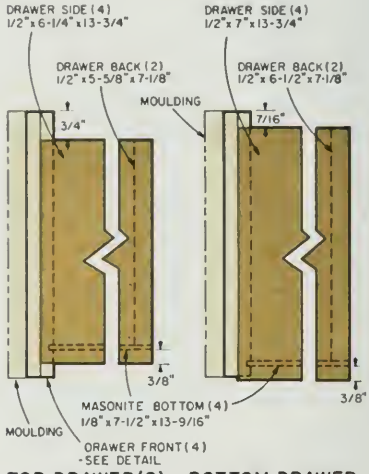
Add wood trim to the front edge of the flip-top, and to the vanity's front apron. Be sure everything is sanded smooth, and use a tack rag to remove sanding dust. Then give the vanity two coats of paint or clear finish, as applied to the drawer fronts. After the finish is dry, install the mirror on the inside of the flip-top.

Original design by Steve Ellingson.

See also: ANTIQUING; DESKS; FINISHING, WOOD; FURNITURE, INDOOR; WOODWORKING.



DRAWER FRONT



TOP DRAWER(2) (PLYWOOD) BOTTOM DRAWER (2) (PLYWOOD)

MATERIALS LIST

Quantity	Size and Description	Purpose
1	3/4" 4'x8' plywood veneer	legs, tops and side panels
1	1/2" 2'x4' plywood	drawers
1	1/8" 30"x5' hardboard	drawer and cosmetic compartment bottoms
1	1/8" 1'x2' plywood veneer	skirt
1	3/4" 6"x30" pine	drawer slides, cleats and piano hinge mount
1	1/2" 3/4"x18' molding	trim
1	1 1/2"x24" piano hinge with screws	
1	12"x18" mirror with mounting clips	

NOTE: Also need flexible wood trim, drawer pulls or handles, 10" lid support, 3d and 5d finishing nails, #8 flat head screws and finishing materials.

How to Ventilate with Kitchen and Bathroom Fans

These blowers can make your house a more pleasant, and possibly healthier, place to live

A FEW DECADES AGO no one worried a whit about home ventilation. There was no need to. Plenty of fresh air seeped in around unweatherstripped doors and windows, more air was "breathed" through uninsulated walls, and if cooking vapors hung too heavily in the oversize kitchen, someone just threw open a couple of windows and fanned most of the extra airborne moisture and grease out with the kitchen towel.

Now that we live in far more complex homes, ventilating problems have become infinitely more important, in fact quite inescapable. The modern home has many new sources of air pollution—more cigarette smoke, more ammoniated cleaners, more spray-about products of all kinds. Highly efficient weatherstripping and wall insulation all but eliminate natural air change. We wash more clothes because we have more clothes, and change them more frequently than did our forefathers. And we all take baths with a frequency that would have made our departed kin blush.

Fortunately, even older homes can be equipped with efficient ventilating units with minimum fuss and bother. Ventilators have been designed to cope with virtually any conceivable location and air-moving problems. There are simple, single-speed fans, and others that offer a choice of two or three speeds. Some have solid-state electronic circuitry to provide nearly infinite selection of fan speeds and sound levels. Others have special controls that sense room humidity and automatically turn on the fans when humidities reach any predetermined, pre-set levels. And you can even get controls having timing devices that turn off fans automatically in your absence.

In recent years the Home Ventilating Institute (HVI), an industry association, has started rating fans in terms of sones of noise. As the noise level goes up, the sone value increases linearly. For example, a 6-sone fan is twice as noisy as a 3-sone fan. HVI has established 9 sones as the acceptable limit for kitchen fans that move up to 500 cubic feet of air per minute (500 CFM); the acceptable limit for bathroom fans is 6.5 sones. Most HVI-certified fans have sone values substantially lower than the maximum acceptable values. However, the wise shopper will check the sone ratings of competing products, and make sure that the cited sone ratings apply to noise levels when the fans are operating at top speeds.

Kitchens. Wall and ceiling fans in kitchens should be located above the range to sweep out cooking moisture and grease

venting: see heating systems, home
vintage radio: see radio
vises: see hand tools
voice transmission: see laser
voltage regulator: see parts replacement, engine

➤ *Decorative stainless steel hood fan for wall installations. U.L. listed, powerful but quiet twin blower powers unit with automatic reset thermal protected motor. Aluminum mesh grease filters are easily removed for cleaning. Unit comes in five finishes, four widths.*

most effectively. That's if you do not use a hood fan over the range. If a hood fan is used, the auxiliary wall or ceiling fan might better be located at the far end of the room from the main source of fresh air.

The shortest possible duct route is usually best. Straight up through the ceiling and roof is especially good because warm moisture and grease will tend to rise, thus making the exhausting job easier. However, you can also exhaust through the house wall, or through the eaves. If more than two or three elbows are required in the ducting, it would be wise to use the next larger capacity fan to overcome the above-normal resistance to air flow. The CFM fan rating for your kitchen, assuming normal ducting, can be obtained from the accompanying table. Or you can make your own calculations based on 15 complete air changes per hour. Just multiply the kitchen floor area, in square feet, by 2 (provided that your ceiling is no higher than 8 feet). For example, if your kitchen floor area is 150 square feet, you would need a 300 CFM rated fan.

You will find kitchen wall and ceiling fans designed for virtually any conceivable ventilating problem. Many use 3¼ x 10-inch rectangular ducts which can be run vertically between 2 x 4-inch wall studs, or horizontally between ceiling joists. Of course, ductwork is completely unnecessary if a wall fan can be vented directly to the outside through the kitchen wall; this is by far the most economical type of kitchen fan.

In a small kitchen you may need no other ventilation than a good range hood. These are usually 5 to 8 inches high, up to 20 inches deep, and from 24 inches to 42 inches long. Vented range hoods require either 3¼ x 10-inch rectangular ducts or round ducts 7 inches in diameter. If you have a counter-mounted indoor barbecue unit next to the range, the hood should be long enough to cover both cooking units. Such oversize hoods may be equipped with "squirrel cage" fans with ratings as high as 900 CFM to ensure rapid removal of smoke and grease. In any event, HVI recommends a minimum of 40 CFM per lineal foot of range hood and 50 CFM per lineal foot for a peninsula or island counter hood. Thus a conventional 36-inch long range hood should have a 120 CFM fan; but a comparable hood placed over a peninsula or island would require a minimum of 150 CFM. Bear in mind that all of these generalizations are based on the estimated needs of small families, and assuming that the fans operate at full speed. If you do more than average cooking at any given time (maybe frequent dinner-partying, for example) you may be better off with fans having higher CFM ratings. Even under normal circumstances there may be times when you will want to clean the kitchen air especially quickly.

Some authorities believe that the fan powers of range hoods recommended by HVI are too low. The Small Homes Council —Building Research Council recommends that for wall hoods the fan capacity should be 100 CFM for each lineal foot of hood length, and that peninsula and island hoods should provide 120 CFM per lineal foot. Thus the 36-inch wall hood would require a 300 CFM fan and a 36-inch peninsula or island hood would require a 360 CFM fan. Thus it would be wise to consider the HVI standards as the minimum for normal use; if in doubt, lean toward more powerful fans, even if not to the lengths suggested by SHC-BRC.

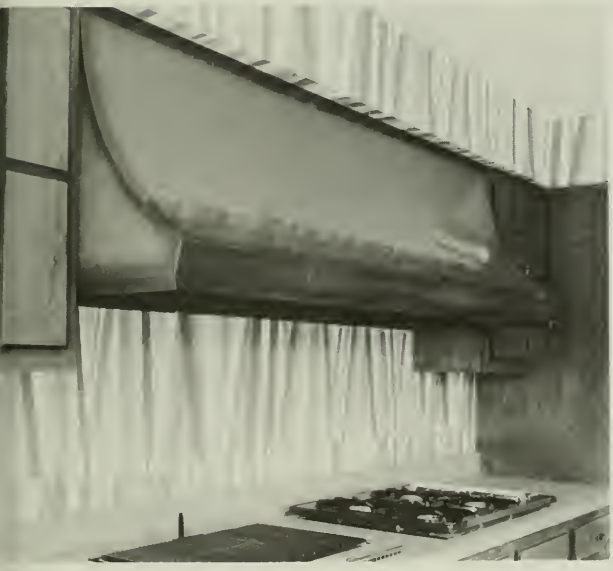
The hood fan may be an integral part of the hood, along with a grease filter. Or you may buy a hood separately to contain moisture and grease long enough for a

Non-duct hood fan is stainless steel with triple filters. Fan speed adjusts to ventilation needs and desired sound level. Activated charcoal and fiberglass filters remove cooking odors and smoke. Unit is available in three widths, five other finishes.

▲ *Attractive and versatile hood fan provides sculptured control panel with safety contoured front edges. Unit has large, permanent washable aluminum mesh filter removable for easy cleaning. Non-glare light illuminates entire range area. Power units are U.L. listed and permanently lubricated.*

➤ *For a silent, extra-clean kitchen, choose outside mounted roof fan. This powerful fan can be used with range hoods for perfect ventilation, keeping all motor sound outside the home. Ideal for heavy-duty needs such as indoor gas-fired barbecues. Blower type fan is powered by 1/6 hp motor, which is permanently lubricated with a 24-inch square aluminum housing with 10-inch duct.*

▲ *This vented hood features a two-speed fan, removable and washable grease filter, rectangular exhaust top or rear, a lamp for illuminating the cooktop and an attractive appearance.*



◀ *Indoor barbecue grill installed in the kitchen counter adjacent to the kitchen range. A ducted hood covers the whole cooking area, including range and grill. This unit has dual "squirrel cage" type fans for rapid removal of smoke and grease from the kitchen.*

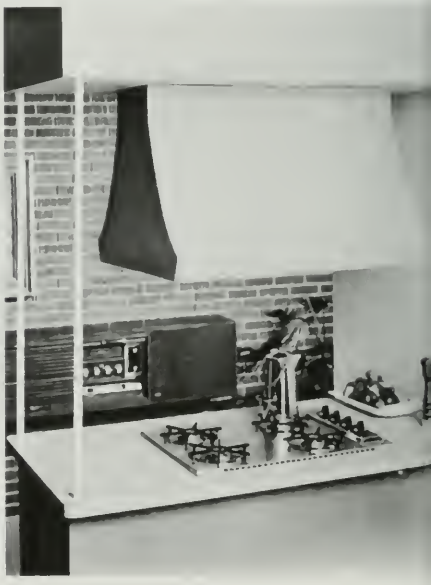
Brushed copper canopy-type range hood has high-rise styling, massive custom look, and moderate price. A gracefully curved height of 24 inches eliminates waste space as well as cost and installation of over hood cabinets. It is available in six colors.

separate wall fan to dispose of it. In any case be sure that the bottom edge of the hood is from 21 to 24 inches above the range, and under no circumstances higher than 30 inches.

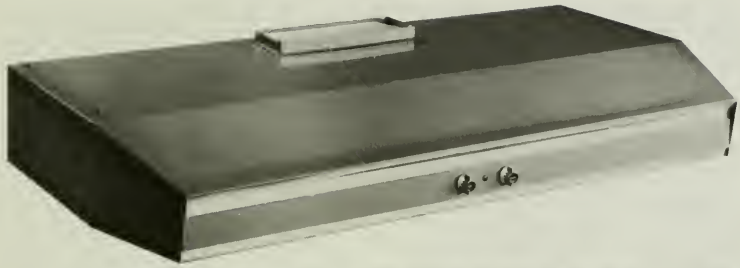
Bathrooms. Fans are highly desirable in bathrooms, not only to eliminate odors, but also to remove moisture which can cause deterioration of wall surfaces and fixtures. Moreover, in many areas an excessively damp bathroom is an invitation to nesting insect pests such as termites and carpenter ants.

A common practice is to locate the fan above the bathtub or shower. This may be acceptable in some cases, but very often it is the poorest place. The best rule of thumb is to locate the fan at the far end of the bathroom from the doorway or window through which most fresh air will enter to replace the air exhausted outdoors. If the fan is over a tub or shower that is close to the door, the toilet area may not be ventilated properly.

The bathroom construction and location will determine what type of fan is most appropriate. Ceiling fans that discharge vertically or sideways are available; vertical units usually have 7-inch diameter ducts while side-discharge units more often use 4-inch ducts. Other types of side-discharge



Twin-faced hood fan for an unusual treatment in kitchens with pass-through counters or islands. Fashion designed hoods with many decorator finishes are economical, since they eliminate the cost of cabinets over the hood. Powerful but quiet twin-blower unit has solid-state speed and sound control and two permanent-type, washable aluminum mesh filters.

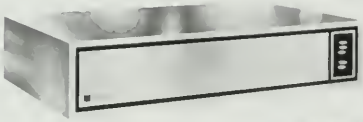


▲ *Fan control gives an infinite number of fan speeds. A fan indicator light and a rotary light switch are included. A new excess heat detector automatically turns on the fan as the temperature reaches 140 degrees F. Should the temperature reach 240, the fan shuts off and a warning sounds. A large 240 square inch washable aluminum mesh filter aids grease removal.*

➤ *Designed especially for bath and powder rooms this fan is less than 4 inches thick. It is quiet and can be installed just about anywhere. This wall or ceiling exhaust blower fan has a two-piece grill and concealed air intake ports. Its beveled frame is in bright aluminum, and the snap-in center panel is brushed aluminum.*

▲ *A flush mount wall fan gives a clean line ventilation concept. Ideal for homes and apartments, these decorator models go anywhere in the residence. This is a powerful, quiet exhaust fan designed for minimum maintenance and maximum beauty.*

▲ *Vented solid-state range hood. For economy installations, this modern unit features sculptured look and eye-level solid-state controls with infinite speed. Fan power unit is HVI certified.*



◀ *Vented hood offers contemporary design. It is constructed of an all-anodized aluminum body, fashioned in a squared front design for the modern kitchen. Air intake adds to efficiency.*

fans, which can be installed in walls between studs or between ceiling joists, have 3-inch diameter round ducts. Perhaps the simplest fan to install is one that goes directly through the wall to the outside; these of course cannot be used in wholly

"internal" bathrooms. When you look for a bathroom ventilator, consider the feasibility of solving some other bathroom problem simultaneously. Some ventilating units also include bathroom heaters; others provide light as well as ventilation.

Obtain the proper fan rating from the accompanying table, or calculate the required CFM value on basis of 8 complete air changes per hour. (Note that in the bathroom, air movement can be much less than the 15 complete changes per hour indicated for kitchens.) Do this by multiplying the floor area, in square feet, by 1.07. For example, if the floor area is 50 square feet, you would theoretically need a 53.5 CFM rated, fan, but you would buy a 60 CFM fan because the ratings increase by increments of 10 CFM.

Laundries. Many homeowners who ventilate kitchens and bathrooms satisfactorily overlook the laundry. Yet this is a very high humidity area where moisture can do much damage. Paint and wallpaper may peel, cabinet doors may stick, pipes and appliances will rust prematurely, and mildew growth may become a serious problem, especially during humid summer months.

Laundry ventilation is achieved with wall or ceiling fans similar to those used in kitchens and bathrooms. Generally, the best laundry fan location is directly over or behind the washer so that moisture is vented along the shortest possible path. Your clothes dryer should be separately vented to the outside.

The CFM capacity of the fan can be determined from the table, or you can make your own calculations by figuring what capacity fan would change the air in the laundry six times each hour. Just multiply the laundry floor area, in square feet, by 8 and divide the product by 10. For example, if the floor area is 150 square feet, you would need a 120 CFM rated fan.

See also: BATHROOM; KITCHENS; LAUNDRY ROOMS; NOISE.

KITCHEN VENTILATION

Floor Area (Sq. Ft.)	CFM*
60	120
70	140
80	160
90	180
100	200
125	250
150	300
175	350
200	400
225	450
250	500
275	550

*Wall or ceiling fan ratings in cubic feet per minute of air movement. Does not apply to range hood fans.

BATHROOM VENTILATION

Floor Area (Sq. Ft.)	CFM*
35	40
45	50
55	60
65	70
75	80
85	90
95	100
105	110

*Wall or ceiling fan ratings in cubic feet per minute of air movement.

LAUNDRY VENTILATION

Floor Area (Sq. Ft.)	CFM*
50	40
75	60
100	80
125	100
150	120

*Wall or ceiling fan ratings in cubic feet per minute of air movement.

How to Repair Waffle Irons and Grills

These devices are extremely simple and there is very little that can go wrong with them beyond a frayed cord and stuck thermostat

ONCE WAFFLE IRON GRIDS have been properly seasoned and well-oiled, your waffle iron should give long care-free service. This is providing the batter has been made with enough shortening. Many successful cooks have found it helpful to use more shortening than a recipe calls for.

Cleaning a grid that has had batter burned on it requires patience and lots of scraping. The dark color of a grid does not matter. It is only the cooked batter that must be removed. After this has been done the grids must be conditioned again before using. This is usually done by coating the grids liberally with cooking oil and letting the waffle iron run for about a half hour without batter. Never wash the grids with detergent. That will remove the oil that has saturated the pores of the metal and the waffle iron will have to be reconditioned.

Some waffle irons have interchangeable grids. The waffle grids can be removed and replaced by smooth grids for toasting sandwiches or, when left open, they provide two flat cooking surfaces on which bacon and eggs can be fried, or pancakes.

Thermostat adjustment will provide controlled temperatures up to 500° F, which is enough to cook any of our foods.

In some models the grids are held in place by a thumbscrew; in others there is a latch. Removing the grids exposes the heating element and thermostat. We strongly recommend that the grids be removed while the unit is cool and disconnected from the power line.

Most waffle irons are designed to operate on a normal 115-volt 15-ampere house circuit. Electrically the two heater elements (1 upper and 1 lower) may be connected either in series or in parallel. The preference seems to be series because there is not much advantage in baking a waffle on only one side.

Some waffle makers have no pilot light but do have a glass lens set in the cover over the heater element so its glow can be seen. This serves as a pilot light.

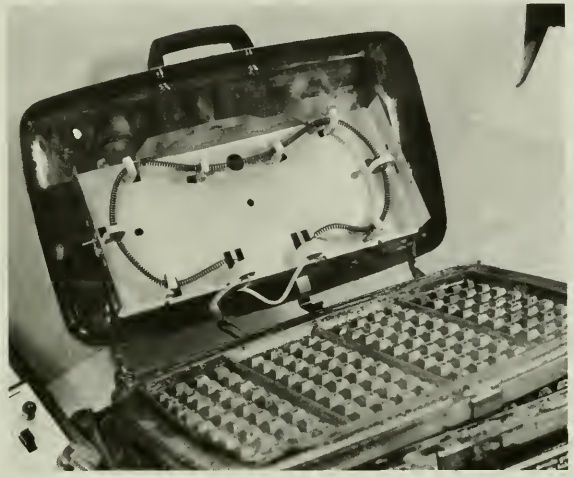
The temperature is controlled by an adjustable bimetal type of thermostat having an off position. The thermostat is factory adjusted to insure the off position at room temperature and a maximum temperature of about 500° to 525°F. This control should hold even if the waffle iron is left turned on, with cover closed, for many hours. Do not fool around with the thermostat to "improve" its operation unless something has happened to it that prevents it from turning off. This is usually due to the contact points being stuck together. They can be separated and cleaned. If the thermostat will not turn the unit on, the trouble may be in some other part of the electrical circuit.

The analysis included in the electrical test drawing should help you to locate this problem. Always make certain that power is available at the outlet.

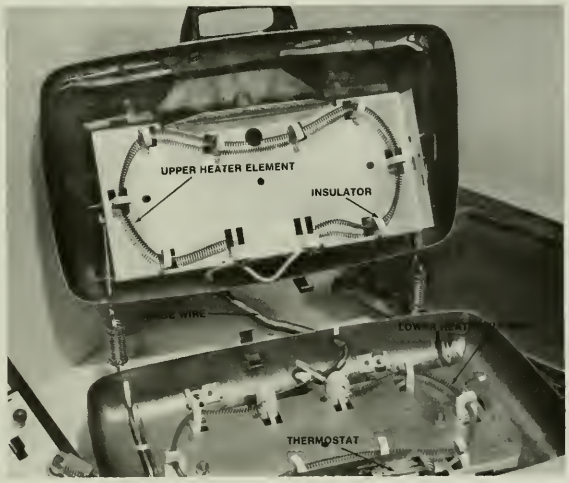
The wire used inside a waffle iron to con-

nect from the upper to the lower element is usually stranded nickel insulated with asbestos. The other connected wire inside the unit may be solid nickel and will be asbestos insulated. Do not use copper wire with plastic insulation because it will have a very short life.

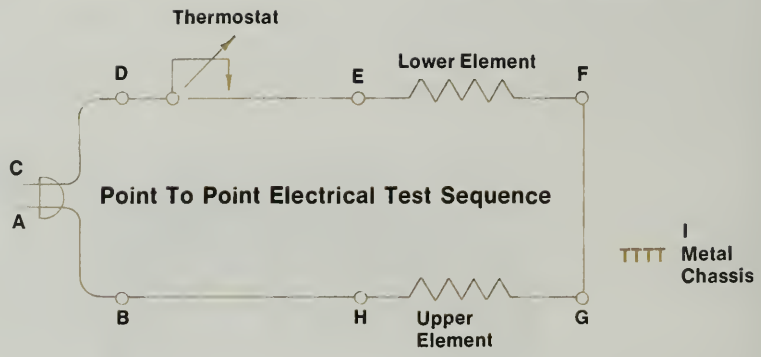
The heating elements are a nickel chromium alloy designed for their operating temperatures and must not be shortened or



➤ *Grid of this waffle iron is held in place with a clip. This makes it easy to remove the grid and replace it with a flat smooth griddle surface for toasting sandwiches and other cooking.*



➤ *Removing the waffle iron grid surfaces exposes interior wiring and heaters for servicing.*

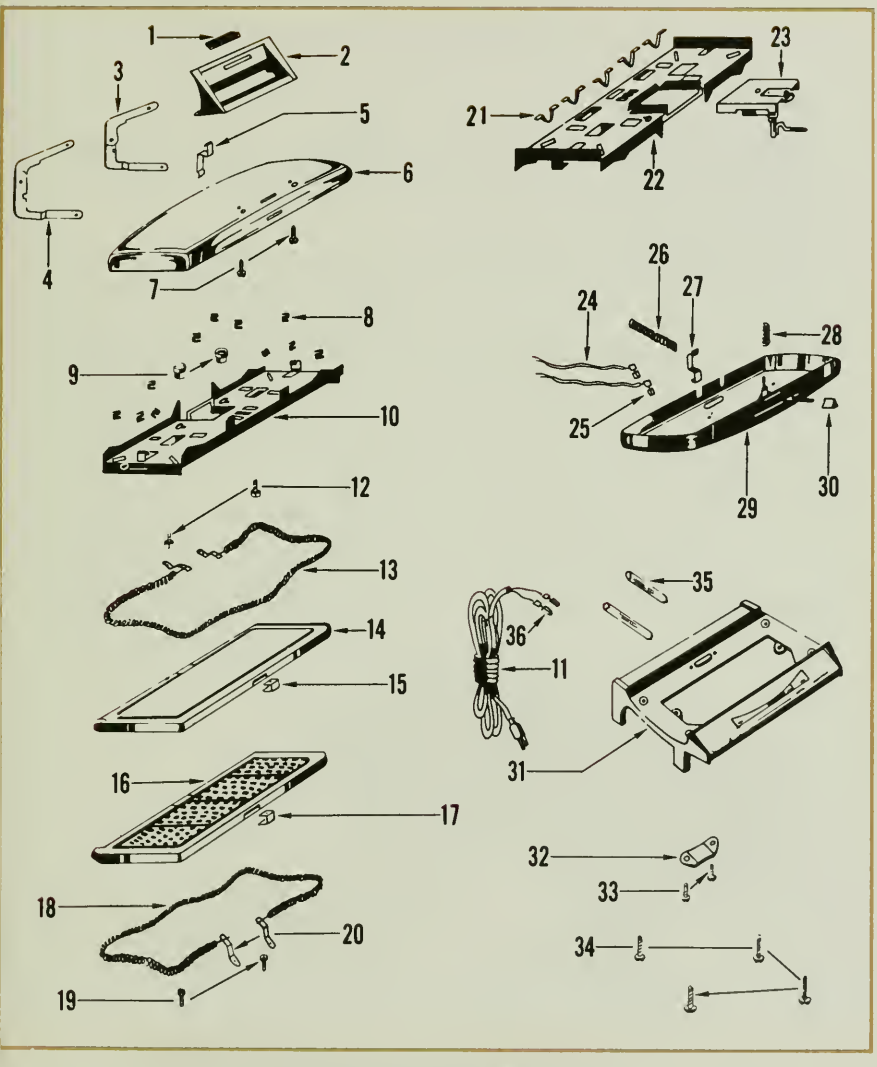


Test Points	Correct Ohmmeter Readings	Possible Cause Of Incorrect Reading
A to B	0 Ohms	∞ = Open Power Cord
C to D	0 Ohms	∞ = Open Power Cord
D to E	0 Ohms	∞ = Defective Thermostat
E to F	5 — 10 Ohms	∞ = Open Heater Coil
F to G	0 Ohms	∞ = Open Hinge Wire
G to H	5 — 10 Ohms	∞ = Open Heater Coil
H to B	0 Ohms	∞ = Open Hinge Wire

Note 1. Thermostat in *ON* Position. Thermostat in *OFF* position will read infinity (∞).

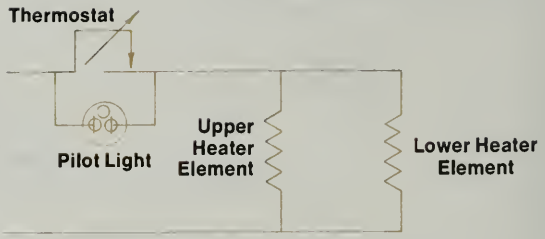
2. Resistance will vary with wattage rating upper element may have a lower resistance than the lower element.

REF. NO.	PART NAME	QTY.
1	Lens	1
2	Handle	1
3	Hinge Assembly, Right	1
4	Hinge Assembly, Left	1
5	Clip, Upper Shell	1
6	Shell, Upper	1
7	Screw, Upper Handle	2
8	Insulator, Element	22
9	Insulator, Element Terminal	4
10	Support, Element	1
11	Cord Set	1
12	Screw	2
13	Element and Terminal Assembly	1
14	Upper Grid	1
15	Retainer, Grid	1
16	Lower Grid	1
17	Retainer, Grid	1
18	Element and Terminal Assembly	1
19	Screw, Element Frame	2
20	Terminal, Element	4
21	Tab, Insulator	10
22	Support, Element	1
23	Thermostat Assembly	1
24	Lead	2
25	Connector	2
26	Conduit Assembly	1
27	Clip, Lower Shell	1
28	Spring, Lower Shell and Stud	1
29	Lower Shell and Stud Assembly	1
30	Knob	1
31	Base	1
32	Strain Relief	1
33	Screw, Strain Relief	2
34	Screw, Leg	4
35	Insulation Sleeve	2
36	Connector	2
37	Connector	2

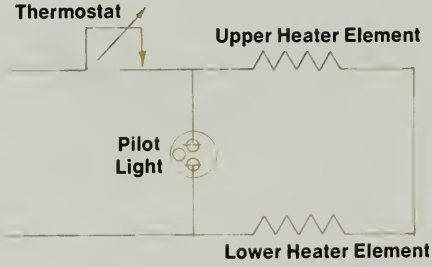


▲ *The parts and assemblies of a typical waffle iron. Use the key on opposite page to identify the parts.*

Pilot light in the waffle iron with parallel heater elements (A) turns ON when the griddle is hot enough to use. Pilot light in the series-wired waffle iron (B) turns OFF when the griddle is hot enough to use. Either pilot light method may be used with either heater-wiring system.



A. Heater Elements Parallel Connected



B. Heater Elements Series Connected

patched with some other kind of wire. The insulators are porcelain.

All these special materials are used to provide a long safe life for the appliance.

After working on the appliance make certain all electrical connections are secure and that all bare wires are secure and clear of the metal shell. It would be wise to use your ohmmeter to test from the metal shell to the wire connections at the thermostat. The reading should be ∞ (infinity) or an open circuit. G.M.

See also: APPLIANCE REPAIR; ELECTRICITY; INDIVIDUAL APPLIANCE LISTINGS; WIRING, ELECTRICAL.

WAFFLE IRON/GRILL TROUBLE-SHOOTING CHART

PROBLEM \ POSSIBLE CAUSE	DEFECTIVE CORD	OPEN HEATER ELEMENT	DEFECTIVE THERMOSTAT	BROKEN HINGE WIRE	SHORTED WIRE	INCORRECT THERMOSTAT SETTING	INSUFFICIENT SHORTENING	GRIDS NOT SEASONED	OPERATOR ERROR
NO HEAT	√	√	√	√					
OVEREATS			√			√			
BLOWS FUSES	√			√	√				
WAFFLES STICK*							√	√	√

*Too much sugar in batter, opening griddle too soon and not waiting long enough for pre-heat will also cause waffles to stick.

Build a Patio Flower Wagon

This interesting wagon-like device is designed to be used as an outdoor planter

NOT ONLY IS THIS a most attractive addition for your lawn or patio, it is completely operable, and may easily be wheeled from different locations on the lawn or patio as the lawn is being mowed or the patio cleaned. It holds up to a dozen potted plants.

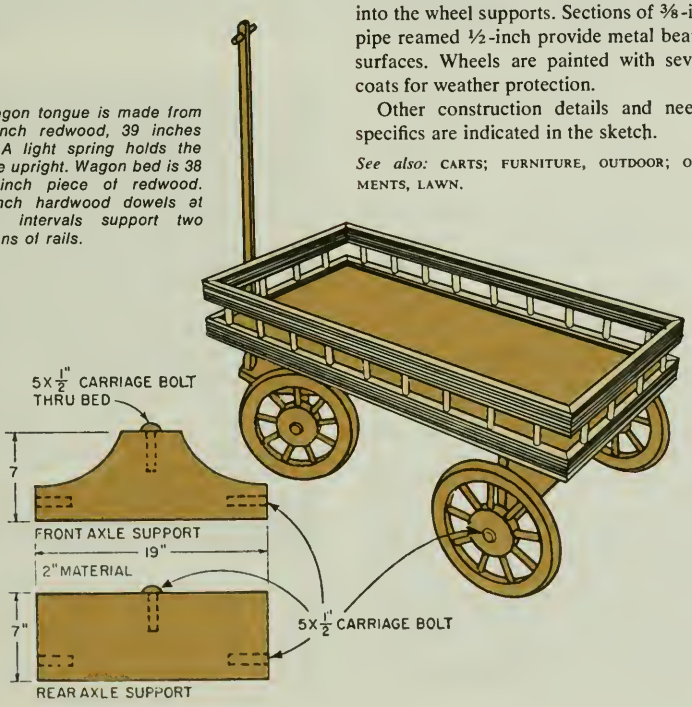
The wheels are not difficult to make. Rounds are cut from 2 x 12 material, pine or hardwood, with a finished dimension of approximately 11 inches in diameter. The hubs are cut from the same piece and are 4 inches in diameter.

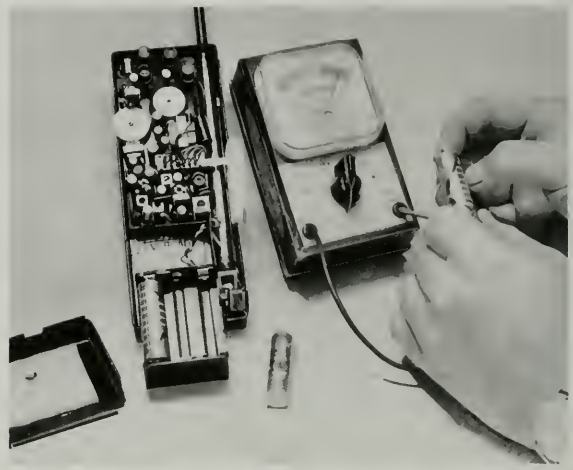
Half-inch hardwood dowels are the spokes. Half-inch diameter holes are drilled through the wheel rims and hubs at 40° intervals. The dowels are inserted and glued through the wheels and into the hubs and dowel projections sanded or turned flush with the wheel perimeters. The axles are made from ½ x 5-inch bolts and extend into the wheel supports. Sections of ⅜-inch pipe reamed ½-inch provide metal bearing surfaces. Wheels are painted with several coats for weather protection.

Other construction details and needed specifics are indicated in the sketch.

See also: CARTS; FURNITURE, OUTDOOR; ORNAMENTS, LAWN.

Wagon tongue is made from 1 x 1-inch redwood, 39 inches long. A light spring holds the tongue upright. Wagon bed is 38 x 19-inch piece of redwood. Half-inch hardwood dowels at 3-inch intervals support two sections of rails.





➤ *Check those small dry cells first. If you don't have a battery tester, check voltage with the "talk" button depressed. If one or more dry cells are low, replace all. Be sure dry cell contact surfaces are shiny bright or else you lose volts.*

Walkie-talkie Repair

These easy-to-do procedures will heal most walkie-talkie ailments

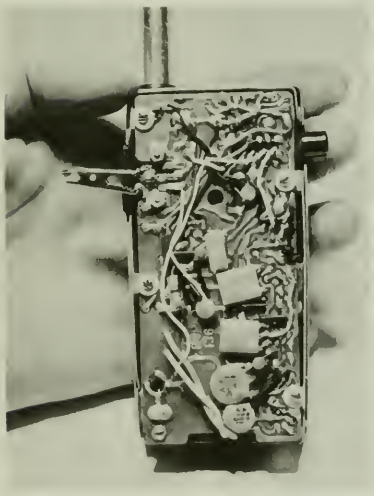
DON'T GIVE UP ON THAT sick walkie-talkie. You can fix it yourself by following these steps to CB walkie-talkie repair. You don't have to be a CB expert nor an expert technician to make minor repairs. Most troubles are simple and easy to locate. Only a few hand tools are needed, and they are probably in your workshop now. Have a little patience and proceed with this step-by-step guide. Remember, most CB troubles are easy to repair. It's finding the trouble that takes knowledge, and this is offered here.

See also: ANTENNAS; CITIZEN'S BAND RADIO; ELECTRONICS.

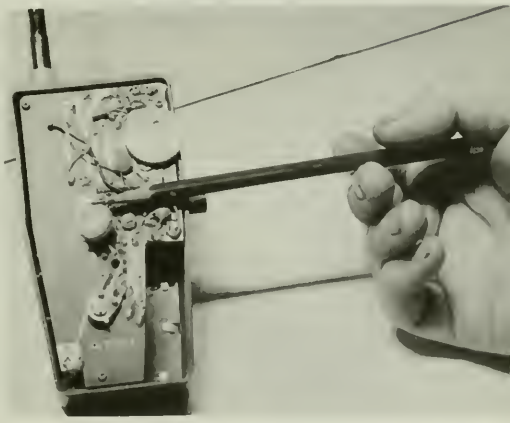
▲ *One big headache common to battery equipment is loose battery leads. Use a small-tip, low-wattage solder iron while making repairs. Apply enough heat to make a good solder joint and stop. Nose around for other loose connections or cold solder joints in the printed circuit board. Check switch connections, too.*

walks and paths: see brickwork
wallbed unit: see beds

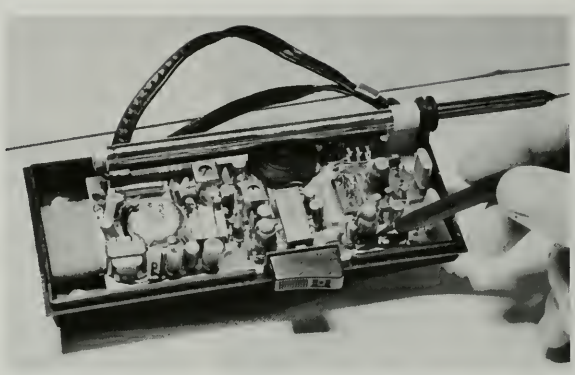
Walkie-talkie antennas usually break with time because of the abuse they take. Don't toss out the unit because its sky hook snapped. Multi-section antennas are available at most parts suppliers and can be installed in your unit. Be sure to select an antenna that comes close in length to the original. A longer antenna does not mean better reception or more signal out —it may mean poorer operation because of detuning.



If your unit will not go on the air, then it's time to push, poke, and pull to detect loose components, snapped wires, etc. Poor or marginal connections are responsible for most transmitter problems. Better go back and do some careful inspecting and soldering.

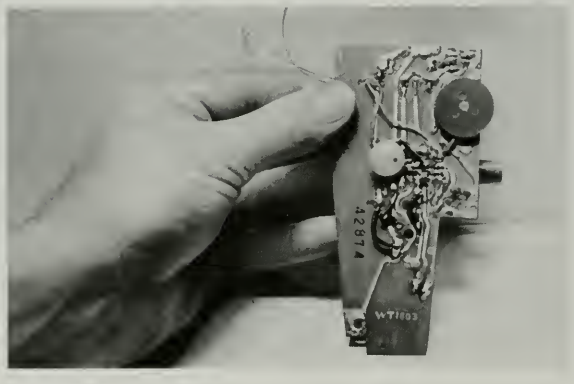


If you cannot turn your walkie-talkie on and the batteries are good, than you most likely have switch trouble. The on-off switches in most portable walkie-talkies are flimsy and break easily. Use an alligator clip across the switch connections—if this works, a new switch is needed.



No reception? In superhet models this means trouble in unit's front end as a rule. Check antenna coil for broken leads or loose connections. Travel from antenna to audio section touching transistor leads as you go. As soon as buzz comes from speaker, you know trouble is in previous transistor stage. Check for physical defects and damage before yanking out any transistors.

Push-to-talk switches cause a lot of trouble because of dirty contacts. It's not the switch's fault. The unit's low cost prevents use of hermetically-sealed switches, so dirt and dust will foul up the contacts. Use one of the many contact cleaners currently on the market. A short spray and a dozen switch pushes should clean up any trouble in your rig.

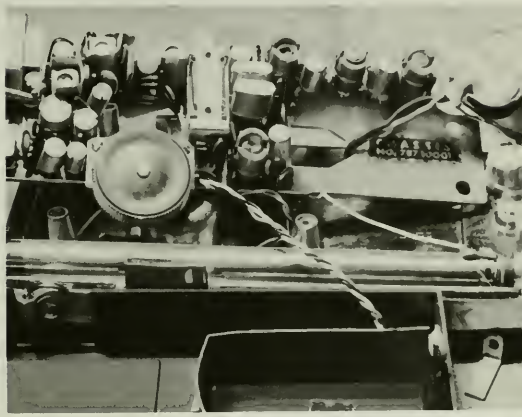


If you drop a walkie-talkie, you have to pay the price. In this case it means removing the printed circuit board and patching it up if necessary, not to mention the epoxy work needed on the case.

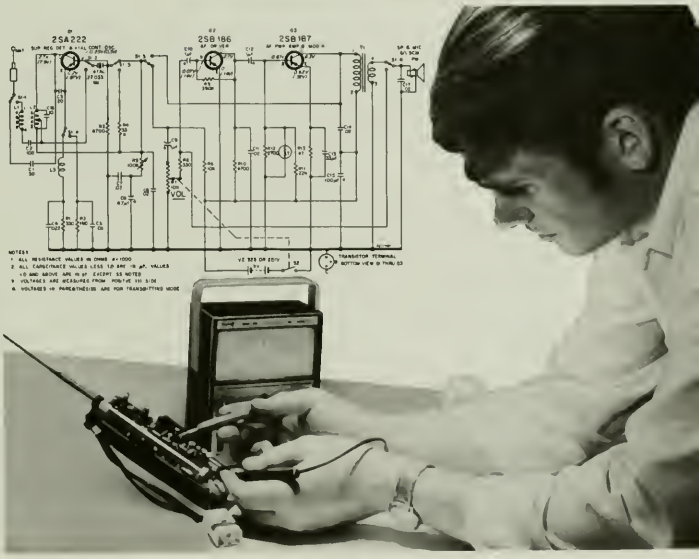
Walkie-talkie Repair

The sound from walkie-talkies is never hi-fi, but it can get worse with time because dirt, dust, humidity, and what-not tear, jam, warp, etc., the speaker cone. A quick test is to listen to the receiver at low volume—if it still sounds bad, it's time for a new speaker. Most jobs are 8-10 ohm units available from electronic supply houses. Pick a PM speaker replacement with the exact dimensions as the original.

If your receiver looks like it was salvaged from a vacuum cleaner bag, it's due for a thorough cleaning. Here's where old-fashioned spit and polish will pay off. Use Q-tips and water-color brushes to wipe and brush away the gook. You'll be surprised at the defects that can be uncovered this way.



If the first steps do not get your walkie-talkie on the air, you're in for some dog work. Most rigs come supplied with schematic diagrams—use them to pinpoint trouble. Make resistance measurements and continuity checks. Use the lowest scale setting when possible and likewise for voltage checks. If a transistor tester is available, check each transistor. It's wise to compare measurements against your other unit, if you own a pair.



How to Install Gypsum Panel Walls

This inexpensive material offers the same smooth, continous surface as a plastered wall, and it can be installed by any home do-it-yourselfer of average skill

ONE OF THE EASIEST AND least expensive ways of covering the bare framing of a new wall is with gypsum paneling.

When properly applied, gypsum paneling provides the same smooth, continuous surface as actual plaster, but requires much less skill and effort to install.

Gypsum paneling is somewhat more difficult to put up than paneling of wood or plastic veneer, but it is more durable, easier to patch when it has been damaged and offers more resistance to noise and fire. In addition, gypsum paneling can be painted and repainted, papered and re-papered over the years, as the decor is changed.

Gypsum paneling, also called wallboard or plasterboard, comes in sheets four feet wide and several thicknesses. It is available in lengths from seven to 14 feet. Each panel is made of plaster laminated all around with a coating of strong, heavy paper. The long edges of each sheet are tapered—some are also rounded—so that the joints can be made invisible once the paneling is nailed in place.

Wallboard can be installed vertically or horizontally. Choose the method which will require the fewest joints. In most modern construction, for example, ceilings are low —from 8 feet to 8 feet 2 inches high. This means that any wall 14 feet long or less can be paneled with two horizontal panels. Any slight gap at floor or ceiling can be concealed with a baseboard or molding.

If you install panels horizontally, make sure any vertical end joints are staggered, like bricks.

The four-foot width of the wallboard panels makes vertical installation suitable for walls built with studs on either 12- or 16-inch centers. The vertical edges of the panels should fall at the studs. Generally, vertical installation is preferred when ceiling height exceeds 8 feet 2 inches.

Gypsum board is easy to cut. Measure and mark the length on each side of a sheet. Line up a straightedge with the marks and score the panel with a knife along the straightedge. Cut through the paper and part way into the plaster. Then, simply snap the panel by bending it away from the score. Complete the cut by slicing through the back paper. Smooth the cut edge with coarse open-grit sandpaper on a block, taking care to keep the edge square. Always score the panel on the face side.

Nailing is the best method for the householder to use to attach the sheets to the wall,

wallboard, insulating: see panels
wallboard repair: see patching
wall cabinet: see cabinets

➤ *Applying gypsum paneling. Note how the end joints are staggered. Actually, this job would be done better by using longer sheets of paneling that go from floor to ceiling. The fewer the joints, the better the job.*

➤ *Completing a cut in a sheet of gypsum paneling by cutting the back paper with a knife. Previously, the opposite side of the cut was scored with the knife and the panel was snapped along the score.*

although adhesives and screws are also used, mostly in large commercial operations.

Be sure to use the nails specified by the manufacturer of the gypsum sheeting. Generally, annular ring nails are used, 1½-inch for ¼-, ⅜-, and ½-inch paneling and 1⅜-inch nails for ⅝-inch paneling. Using the correct nail is important. If nails are too short, they won't hold. If they are too long, the expansion and contraction of the wood is more likely to pop them out through the surface of the wall and mar its appearance.

The way the nails are driven is also important to the quality of the job. Use a special wallboard hammer. Drive each nail slightly below the surface of the panel. When the nail is driven correctly, the head is sunk in a dimple in the surface formed by the head of the hammer, but the paper is unbroken.

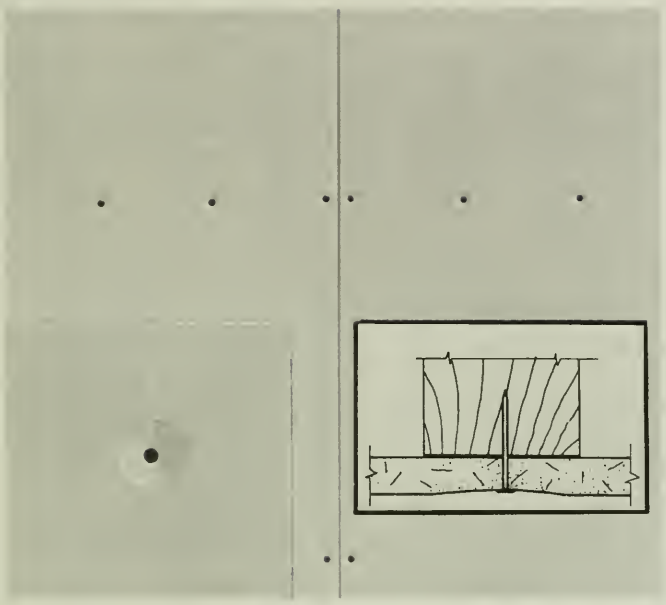
Practice this technique on scrap until you are confident you can do it most of the time. When you are installing a panel on the actual wall and you drive a nail in too deeply, drive in another nail correctly about two inches away. When you nail a panel, start at the middle and work outward. Each time you drive a nail, make sure that the panel is firmly seated against the stud or joist behind it.

If you are covering a ceiling as well as a wall, do the ceiling first, and get someone to help you if you can. If there is no help available, build two T-braces. Each is simply a length of 2 x 4 with a 2- or 3-foot length of 1 x 4 nailed across the top like the cross bar of a T. Make the 2 x 4 long enough so that you can wedge the T-brace between the floor and a sheet of paneling on the ceiling. Two of these will hold the panel firmly against the ceiling while you nail it in place.

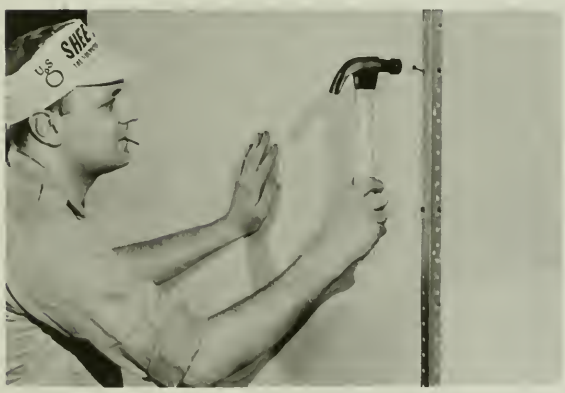
When paneling a ceiling with plasterboard, always install it across the joists. Drive the nails no more than 7 inches apart on the ceiling, 8 inches on walls.

Wall cutouts for electrical outlets and switches and the like are cut with a keyhole saw. Measure carefully and make the cutouts before the panel is nailed to the wall.

Finishing a cut with coarse open-grained sandpaper on a sanding block. When finishing a cut, take care to keep the edge square.



▲ *How gypsum panel should be nailed. Use a wallboard hammer. Drive the nail so the hammer leaves a dimple in the surface, but does not break the paper.*



➤ *Nailing on a corner bead. Nail the bead through the paneling to the stud beneath. Space nails nine holes apart.*

Outside corners require a corner bead. The corner bead is cut to length by snipping the flanges with tin shears and bending the bead until it breaks. When the bead is in place, the metal edge running down the length of the apex of the corner will provide a guide for the knife when you finish the corner with jointing compound. When the

joint is complete, it will resist the wear and tear that corners ordinarily receive.

When all the panels are nailed in place, check your work. Each nailhead should be sunk in a dimple. If you find any nails driven so deeply that the paper surface of the panel is broken, drive in another nail near it. If a nailhead has popped out, press the paneling against the stud and redrive it. Put in another nail near it.

When you are satisfied with the nailing, it is time to tape the joints and fill the nail holes and any damage to the paneling.

The joints are filled with a special spackle-like compound and reinforced with paper tape. Since the long edges of the panels are tapered, they form a slight valley when they are butted together. The jointing compound and the reinforcing tape fill the valley level with the rest of the surface of the paneling. This is why the joints are invisible after the wallboard has been painted.

On some gypsum panel systems, one jointing compound is used. Others require two different compounds. Consult your supplier about this. Generally, the compound must be protected against freezing temperatures and kept free of contamination. If it is not pre-mixed, mix the compound exactly according to directions. In addition to compound and an ordinary kitchen breadpan to hold it in, you will need a 4-inch jointing knife and a 6- or 10-inch finishing knife.

To tape a joint, apply a large daub of compound across the joint with the 4-inch knife and level it by drawing it along the joint. Leave no bare spots. When the joint is covered all along its length with a stripe of compound wider than the tape, immediately apply the tape along the joint. Center the tape over the depression, pressing it firmly into the wet compound, but leave enough compound under the tape to form a strong bond. Embed the tape by applying a thin layer of compound over it to fill the valley formed by the tapered edges of the panels. Allow the compound to dry. When taping end joints, do not overlap the tape applied at the edge joints.

In some wallboard systems, a special jointing compound is applied to the joints and allowed to dry before tape is applied. Once the special compound has dried, proceed with the taping as you would for any other joints.

When the joints have been taped, coat the nail holes with jointing compound. First, draw a bare jointing knife over the nail depression. If you hear a ringing sound—the sound of the knife blade striking the nailhead—drive the nail slightly deeper.

Be careful to dimple the surface but not break the paper. Fill the depression with a single stroke of the knife and level it with a back stroke. When all joints have been taped and all nail holes and marks in the surface have been filled, allow all compound to dry for 24 hours.

After a 24-hour wait for drying, smooth all the jointing compound with fine, open-grain sandpaper to level the surface. Do not use a power sander at this stage or for any subsequent sanding. Wipe away sanding dust with a damp cloth.

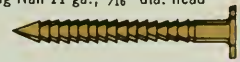
Apply the second jointing coat over the first with the 6- or 10-inch jointing knife. The second coat should be 2 inches wider on each side than the first coat. Feather each edge by pressing the knife as it rides on the panel. End joints should be treated in the same way, but the second coat should be about seven inches wide.

Give each nailhead, or other patch, a second coat of compound and allow the whole job 24 hours drying time.

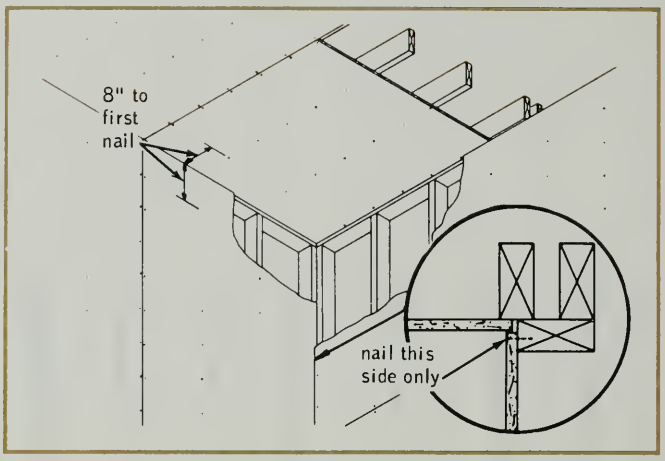
The third and final coat is applied in the same way as the second coat, but it should be about 2 inches wider on each side. Each nail hole also gets a third coat. When all the compound of the third coat has dried for 24 hours, smooth all imperfections and high spots with fine, open-grained sandpaper on a block.

To tape an inside corner joint, first butter

Selector Guide for Gypsum Panel Nails

Fastening Applications	Fastener Description	Nail Spacing c. to c. (1)	Approx. Lbs. Nails Req'd per MSF SHEETROCK
½", ⅜" and ¼" SHEETROCK Gypsum Panels; ½" and ⅜" BAXBORD Gypsum Backing Board to wood frame	1¼" GWB-54 Annular Ring Nail 12½ ga.; ¼" dia. head with a slight taper to a small fillet at shank; bright finish; medium diamond point; meets ASTM C380	7" ceiling 8" walls	5¼
⅝" SHEETROCK Gypsum Panels to wood frame	1⅜" Annular Ring Nail (Same as GWB-54 except for length)	7" ceiling 8" walls	5¼
⅝" SHEETROCK FIRECODE Gypsum Panels face layers to staggered wood studs over ½" USG Wood Fiber Sound Deadening Board	2¼" 7d Gypsum Panel Nail Cement Coated, 13 ga., ¼" dia. head	7" walls (face layer)	9
⅜" and ¼" SHEETROCK Gypsum Panels over existing surface, wood frame	1⅞" 6d Gypsum Panel Nail Cement Coated, 13 ga., 1¼" dia. head	7" ceiling 8" walls	6¼
⅝" SHEETROCK FIRECODE Gypsum Panels to wood frame	1⅞" 6d Gypsum Panel Nail Cement Coated, 13 ga., ¼" dia. head	6" ceiling 7" walls	6¾
½" SHEETROCK FIRECODE "C" Gypsum Panels to wood frame	1⅝" 5d Gypsum Panel Nail Cement Coated, 13½ ga., 15/64" dia. head	6" ceiling 7" walls	5¼
⅝" SHEETROCK FIRECODE Gypsum Panels; ⅝" BAXBORD FIRECODE Gypsum Backing Board to steel nailing channel	1¼" Fetter Annular Ring Nail 11 ga., 5/16" dia. head 	6" ceiling	6
TEXTONE Vinyl Panels (27 finishes) to wood frame	1⅜" USG Matching Color Nail (Stainless Steel)	8" walls	2½
	1⅞" USG Matching Color Nail (Stainless Steel) (Special Order)	8" walls	4½

NOTES: (1) Spacing shown are for single layer application without adhesive.



▲ *When paneling both walls and ceiling, this floating joint system will provide improved resistance to cracking caused by expansion and contraction of the framing of the house. The corner between wall and ceiling can be taped, but for greater stress relief, merely conceal the untaped joint with molding.*

▼ *Cross section of taped joint. The v-groove in this paneling formed by the rounded edges is filled with a special jointing compound. Then, the joint is taped in the ordinary way with taping compound.*

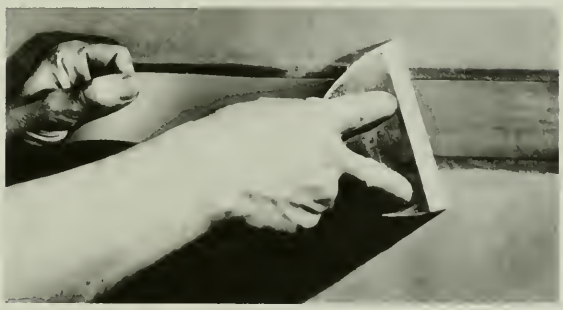
each side of the corner with compound, using the jointing knife. The compound should form a stripe on each side of the corner slightly wider than the tape.

Fold the tape in half along the center, creasing it slightly. You will find that this crease has already been lightly stamped into the tape during manufacture, so it is easy to fold it accurately.

Press the folded tape into the compound with the knife. Press it firmly, but leave enough compound beneath the tape to form a strong bond with the gypsum paneling. Remove excess and let this first coat dry for 24 hours.

Apply the second coat as you would the second coat of a flat joint. Feather the second coat out 2 inches beyond the edge of the first coat. Do one side of the corner and let the compound set. Then do the other

➤ *Applying jointing compound to the v-groove formed by the rounded edges of paneling.*



➤ *Applying joint tape over a layer of jointing compound.*

➤ *Embedding tape with an additional layer of compound. This operation completes the first coat. After a 24-hour wait to allow the first coat to dry, sand lightly and apply second coat.*

side. Apply the third coat in the same way, after the second coat has dried for 24 hours and has been sanded.

Outside corners are easier. Use the jointing knife to apply jointing compound over the flange of the corner bead. Apply enough to cover about two feet of flange at a time. Level the compound by allowing one side of the knife to ride on the bead and the other side to ride on the paneling itself.

Fill the flange completely with compound and allow the compound to feather out onto the face of the paneling to a width of at least 4 inches. Apply the second and third coats in the same way, sanding between each coat and allowing each coat a 24-hour drying period. Remember that each coat is feathered at the edge beyond the edge of the preceding coat by about 2 inches.

Any number of primers and sealers and undercoats are available for wallboard. Consult your supplier about which to use. After the primer coat is applied, treat the wall as you would an ordinary plaster wall.

In addition to new work, wallboard can be applied over existing walls, as long as the surface is flat and the structure is sound. Simply nail through the old wall and into the studs or joists. If it is necessary to use firring strips, use at least 2 x 2-inch stock, unless you can nail through the firring into the existing framing.

Special-purpose plasterboard is available for a variety of applications. For example, you can use special water-resistant board for high-moisture areas such as kitchens, bathrooms or laundries. This wallboard also forms a sturdy, easy-to-apply base for wall tiles. F.C.

See also: ADDITIONS, HOME; HOME IMPROVEMENT; PANELS; PARTITIONS; PATCHING.

▲ *Covering a nail hole with jointing compound.*

▶ *Applying creased tape to an inside corner.*

▲ *Filling cracks and holes with patching compound is an essential step in preparing a wall lor covering.*

How to Prepare Walls for Papering

If you want a wall covering that is free of cracks, bulges, wrinkles or loose spots, you must hang it on a smooth, clean surface

SURFACE PREPARATION CAN make the difference between a professional-looking job of wallpapering and an amateurish one.

The purpose of preparing the wall is to provide a clean, even surface that the new wall covering can adhere to, without showing any bumps, cracks or depressions.

If the wall you want to paper is already covered with one or more layers of wallpaper, the safest course is to remove the old wall covering and start with a fresh surface. It is possible to hang new paper over old and achieve good results, but if you try it you run the risk of discovering a loose spot while you are in the middle of putting up new paper. Also, a wall covering pasted over an old layer of paper can develop troublesome bubbles.

Never attempt to paper over removable vinyl wall coverings, or over any other slick, water-repellant surface. Fortunately,

vinyl wallpaper is easy to remove. You just work a corner or an edge loose and pull it off with our hands.

Removing paper wall covering of the traditional type is more work, but you can save a lot of effort if you rent a steamer. This device is simply an electrically heated boiler that generates steam. The steam travels through a long, flexible tube to a flat applicator.

To use a steamer, simply place it in a convenient location and hold the applicator against the wall. The steam penetrates the old wallpaper and softens the paste underneath. When the paste is soft use either a broad putty knife, or an inexpensive wallpaper scraper specially designed for the job, to peel off the old paper.

When you are finished scraping off the paper, wash the wall with steel wool and a washing compound to remove any traces of paper, glue or wall sizing. Then rinse the wall with clear water and a sponge.

Examine the bare wall and fill any irregularities, such as cracks or holes with spackle. If there is any loose plaster, remove it and spackle the hole.

If the wall is painted, scrape off any loose paint with a putty knife and smooth the edges of the spot with medium-grit sandpaper.

The final step is to apply wall sizing. Use a small brush and a paint roller, just as if you were coating the wall with paint. Sizing is a kind of glue dissolved in water. It fills small cracks and irregularities and can make up for any areas of the wallpaper that might not have sufficient paste, especially at the edges, where some paste is squeezed out when the seam is rolled.

Sizing can also prevent porous or absorbent surfaces, such as old wallpaper, from soaking up paste. When the new paper is hung it will not adhere well, if the surface absorbs too much paste.

Preparing a wall that has been coated with flat paint is relatively easy. All you have to do is spackle it, remove any loose paint, wash it and rinse it. Then apply a coat of wall sizing and the surface is ready to be papered.

Even if the wall looks clean, don't omit the washing. Walls in houses accumulate grease and oil carried in the air from cook-

Before starting on a room, remove fixtures, such as switch plates, wall-mounted lamps, picture hooks and other such items.

The last step in preparing a room for papering is to coat the walls with sizing.

ing, for example, or smog or nearby oil burning furnaces. If the accumulation is great enough, the water soluble paste won't adhere well to the surface and within a short time you could have loose sections of paper drooping from the wall.

Somewhat more work is required for a wall that has been coated with gloss or semi-gloss paint. Sand the wall lightly with medium-grit paper, then wash it with trisodium phosphate or a solution of one part ammonia in six parts water. Rinse it and proceed as you would for any other wall.

To prepare a dry wall for papering, first check the surface for nails that have loosened and popped up above the surface of the board. Drive them back in again so that the last blow of the hammer leaves a depression in the plasterboard and the nailhead is below the surface. Fill each depression and any other irregularities with spackle. Let the spackle dry and re-spackle each patch. After the second application of spackle dries, sand off any high spots. Paint the wall with one coat of an oil-based primer-sealer. Give the primer-sealer time to dry thoroughly before applying wall sizing.

Do not attempt to paper a newly plastered wall until at least 30 days after the plaster was applied. Then fill any irregularities with spackle and paint the wall with one coat of an oil-based primer-sealer. When this is dry, coat the wall with sizing.

Additional tips: remove any fixtures, such as wall-mounted lamps, switch plates, etc., before starting. If you plan to paint the woodwork or other trim, do it before you paper. It's easy to remove spilled paste or sizing from a painted surface. It's extremely difficult, if not impossible, to remove paint from wallpaper.

The actual hanging of the paper can begin once the wall has been sized. F.C.

See also: ADDITIONS, HOME; GARAGE REMODELING; HOME IMPROVEMENT; PAINTING; PAINTING, HOUSE; PATCHING; WALL DECORATIONS.

Care and neatness can overcome a lack of experience in hanging wallpaper. When trimming edges, use a wall scraper to push paper snugly into the angle formed by the casement and the wall and trim with a razor mounted in a holder. Use the wall scraper as a guide while cutting.

How to Hang Wall Coverings

Modern wallpapers are easy to apply and they can do much to establish the mood and character of a room

WALL COVERINGS OFFER the homeowner one of the quickest ways to establish the mood of a room. Unlike paint, which is usually applied in a single color, wall coverings are available in an almost endless variety of colors, patterns and textures.

Most modern wall coverings are fairly easy to hang and can quickly give a room the look you want to achieve—modern or traditional, bright or subdued, formal or informal—the choice is yours.

Once you have selected a pattern, the next step is to estimate how much wallpaper you need. First, measure the height from the baseboard to the ceiling. If the wall has a picture molding around it near the top, measure the distance from the baseboard to the picture molding. Next measure the distance around the room at the baseboard. Finally, measure height and width of openings, such as doors and windows.

You can take these measurements to your dealer and let him figure out how many rolls you need, or you can use the accompanying chart and estimate the number of rolls yourself. Do it this way:

Step 1: Multiply the height of the area you are going to paper times the distance around the room. For example, 8 feet x 48 feet = 384 square feet. This figure is the total wall area.

Step 2: For each door and window, multiply the height times the width. This gives the area of each opening. Add these areas

and you will have the total area of the openings in the wall, 37 square feet for example.

Step 3: Subtract the total area of the openings from the total wall area, 384 square feet — 37 square feet = 347 square feet. The area to be covered is 347 square feet.

Step 4: Divide the area to be covered by 30. 347 ÷ 30 = 11.5. Go to the next highest whole number, which is 12. This is the number of rolls of wallpaper required.

Before going any further, make sure the room has been thoroughly prepared. The surface of the walls must be smooth and covered with wall sizing.

In addition to the wall covering, you will ordinarily need paste, paste bucket and brush, a smoothing brush, a seam roller, a wall scraper or broad-bladed putty knife, razor blades and scissors, a chalk line and weight, a long table and an accurate yardstick with a true edge. If you are hanging pre-pasted wallpaper, you will need a special water tray for soaking the wall covering, rather than a paste bucket. All of these tools are available at the dealer where you buy the wallpaper. The water tray and table can be borrowed or rented.

When you have your equipment and materials assembled, you are ready to start.

First measure the width of the wallpaper and subtract one inch. Measure this distance off from the right edge of the door and make a mark on the wall at the ceiling. Make a plumb line out of the chalked line and a weight—a heavy key will do. Tack the chalked plumb line to the wall at the mark. When the plumb line stops swinging, hold the weight firmly against the baseboard, pull the string away from the wall and let it snap back. This will leave a vertical chalk mark on the wall.

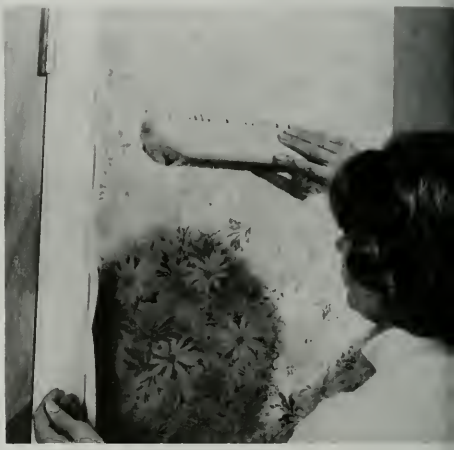
The line will mark the exact position of the first strip of wallpaper once it has been cut and pasted.

Mix the wallpaper paste in cold water

Each end of a pasted sheet of wallpaper is folded toward the middle to make the sheet easier to handle.

Snapping a vertical line. Align the first strip of wallpaper with the chalk line to make sure it is vertical. Subsequent strips will be aligned with the first strip of wallpaper.

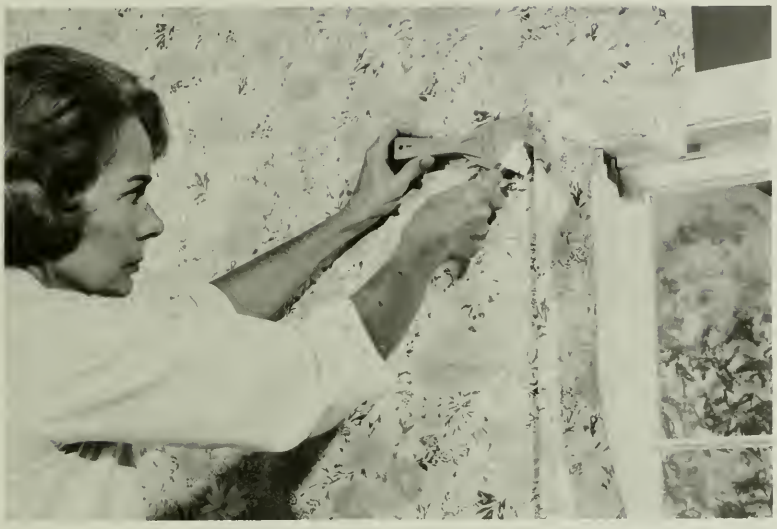
Hanging the first sheet. The ends of the sheet should overlap the ceiling joint and baseboard by a few inches.



Brushing the wallpaper downward with a smoothing brush.

After it is hung, rinse the paper with a well wrung out sponge and wipe any excess paste from woodwork, floor and ceiling.

Trim off excess paper with a razor, using the wall scraper as a guide.



Trimming a corner over a window. Hang the piece first. Then, make a diagonal cut with scissors from the loose edge of the paper toward the corner. Cut across the corner, like a miter joint, and slightly beyond it. This allows the edges at the window to be pushed snugly into the angle between the casement and wall for trimming.

according to the manufacturers directions. It should be free of lumps. If you stick your finger in it, it will adhere like a smooth glove. Tie a string across the top of the paste bucket to hold the brush. This will keep the handle clean.

Unroll a length of wall covering on the table with the pattern side up and cut it six inches longer than the wall height. After it is cut, hold it against the wall to check the length. There should be a few inches overlap at the ceiling and the baseboard.

If the strip is the proper length, put it back on the table, pattern side up and unroll paper for the second strip, matching the pattern on the same side and direction you are working in, and cut the second strip to the same length as the first. Repeat this a few times, but do not cut too many strips in advance. This will prevent mistakes in matching.

Turn the pile of strips pattern side down so that the first strip is on the top. Apply paste with the brush in a figure eight pattern, being sure not to miss any spots. Do the lower half first. Fold the bottom toward the middle with the edges flush, paste-to-paste, and press the two sides of the fold gently together with your hands, but be careful not to crease the fold. Paste and fold the top portion in the same way. This process is called booking.

Wait three to five minutes to allow the booked paper to relax, then carry it to the wall and unfold the top half. Place the paper against the wall so the top edge over-

laps the ceiling joint by about two inches and line up the right edge with the vertical chalk line. Do this precisely because subsequent strips will be aligned with this one.

Tap the upper section with the smoothing brush. Then press it with downward strokes of the brush on the center of the strip, working any bubbles or excess paste out to the edges.

Open the lower fold and slide the section against the wall with the palms of your hands, checking its alignment with the vertical chalk line and brush it with the smoothing brush.

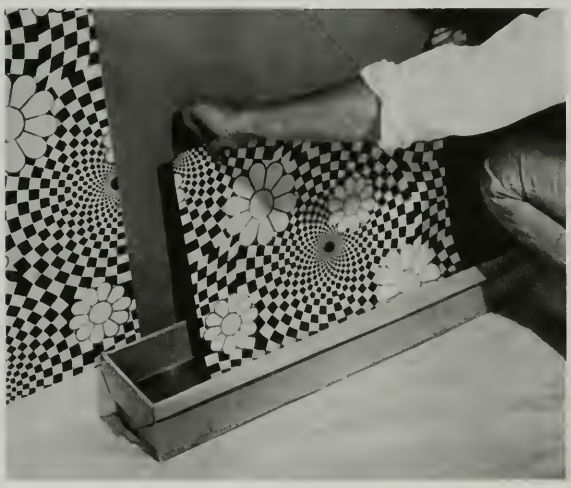
The strip of wall covering will overlap the baseboard, ceiling joint and right edge of the door. Trim this excess with a single-edge razor blade, using the straight edge of a wallscraper or broad-bladed putty knife as a guide. Change razor blades frequently to keep from tearing the paper rather than cutting it.

Use a natural sponge to rinse the newly hung strip of wallpaper with clear water. Squeeze the sponge well to keep water from running down the strip. Also, at this stage, rinse off any paste from the woodwork, floor or ceiling. Be sure to do this before the paste dries.

Follow the same procedure for the second strip, butting the left edge to the right edge of the strip already on the wall. Repeat this process until you get to a corner or a window.

When you come to a corner, measure the distance between the right edge of the last strip and the corner at three places, the top, the middle, and the bottom. Add one half inch to the longest of the measurements and subtract this total from the width of the strip. After subtracting, measure the resulting distance from the corner on the new wall near the ceiling and make a mark. Hang the chalked plumb line through this mark and snap the line on the wall. This will give you an exactly vertical line to start papering the new wall with.

Hang a pasted sheet of paper in the corner, butting its left edge against the right edge of the previous strip. Smoothe the sheet well into the corner. When it is in place, cut the piece vertically about one



Pre-pasted wallpaper is soaked in a water tray before it is hung on the wall.

half inch from the corner on the new wall. Then slide the remaining section slightly to the left, so its right edge lines up with the vertical chalk line. The left edge slightly overlaps the piece that rounds the corner.

Windows and doors are a little easier than corners. Simply cut a strip as you would any other and hang it in place. It should be butted vertically to the preceding piece and cover part of the door or window. Use scissors to snip the paper diagonally from the inside of the door or window outward so that the cut crosses the corner, like a miter joint. Then the excess paper will be able to bend upward above the door or window and the excess at the side will be able to bend on a vertical line. The next step is to trim away the excess with a razor blade.

Wallpaper seams should be rolled with a seam roller to fix them firmly in place. Wait 15 minutes after the sheet has been hung, then roll the butted edges with the roller, firmly but not too hard. Do not roll the seams of flocked wallpaper. Instead, tap them with a smoothing brush.

Pre-pasted wall coverings are hung in exactly the same way as ordinary wallpaper, with one exception. Instead of mixing paste and brushing it on the wall covering, you dunk the covering in a special water tray that is available from wallpaper dealers.

After cutting a strip to size, re-roll it from bottom to top with the pattern inside and place it in the water tray. Roll it loosely so the water can reach all of the pre-pasted surface.

Use tepid water and soak the wallpaper for the exact length of time specified by the manufacturer. To hang it, simply carry the tray to the wall, grasp the end of the roll. As you lift the end toward the ceiling joint, the strip will unroll. Then proceed as you would for ordinary wallpaper. F.C.

See also: HOME IMPROVEMENT; PAINTING; PAINTING, HOUSE; PATCHING; WALL DECORATIONS.

CHART TO ESTIMATE WALLPAPER NEEDS

Distance Around Room in Feet	Single Rolls for Wall Areas Height of Ceiling			Number Yards for Borders	Single Rolls for Ceilings
	8′	9′	10′		
28	8	8	10	11	2
30	8	8	10	11	2
32	8	10	10	12	2
34	10	10	12	13	4
36	10	10	12	13	4
38	10	12	12	14	4
40	10	12	12	15	4
42	12	12	14	15	4
44	12	12	14	16	4
46	12	14	14	17	6
48	14	14	16	17	6
50	14	14	16	18	6
52	14	14	16	19	6
54	14	16	18	19	6
56	14	16	18	20	8
58	16	16	18	21	8
60	16	18	20	21	8
62	16	18	20	22	8
64	16	18	20	23	8
66	18	20	20	23	10
68	18	20	22	24	10
70	18	20	22	25	10
72	18	20	22	25	12
74	20	22	22	26	12
76	20	22	24	27	12
78	20	22	24	27	14
80	20	22	26	28	14
82	22	24	26	29	14
84	22	24	26	30	16
86	22	24	26	30	16
88	24	26	28	31	16
90	24	26	28	32	18

This chart is based on 30 square feet of coverage per single roll of wall covering. Manufacturers usually ship 36 square feet of material per single roll—the 6 square feet deduction provides for normal cutting and matching while hanging.

To reduce handling and packaging costs most wall coverings now come in double roll bolts.

Using Imitation Stone Wall Coverings

You can apply a good looking imitation stone or brick covering to any wall, or section of a wall, in your house without the high cost of the real thing

It looks like cut stone, but it's really plastic applied with adhesive to an ordinary wall. Imitation stone and brick is available in a wide variety of types, colors and textures.

YOU CAN LINE ONE WALL or a whole room in your house with real-looking imitation stone or brick with little difficulty.

The imitation stone is made of plastic and comes in a wide variety of types, textures, sizes and colors. It is sturdy, fire-retardant, non-porous and easy to clean.

Imitation stones and bricks are designed for interior or exterior use, although specify which type you want when making your purchase because different types of adhesives are used indoors and outdoors. The material is light and requires no special support, as real stone would, although a sound surface is necessary for application.

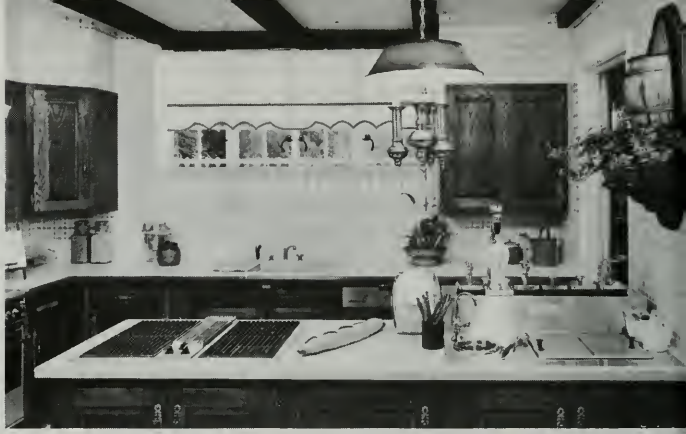
All of the types available either include corner pieces, or can be adapted to fit corners. And some, such as imitation bricks, can be cut to fit small spaces—at the end of a row, for example.

There are two ways of attaching the imitation stones or bricks to the wall. In one, a water soluble mastic (for interior use only) is spread with a trowel and the pieces are simply pressed into it. In the other, tabs are attached to the wall and real-looking stones or bricks are pressed on the tabs. Then, an imitation mortar is squeezed from a tube between the bricks or stones, then smoothed with a special brush supplied with the mortar. The operation is simple and neat.

See also: CONCRETE BLOCKS; FLOORS, BRICK; FOYER; PANELS; WALL DECORATIONS.

▲ *Two different types of imitation brick provide variety in this decor highlighted by an old-fashioned stove painted white to match the white imitation brick of the planter.*

➤ *Apply mortar between pasted-on real-looking cut stones. The job is easy, neat and quick.*



Coordinated counters and walls show an interesting use of decorated ceramic covering. Wall covering is of 6 x 6-inch plaid tile in muted tones of yellow and green on white.

Wall and Counter Decorating Ideas

No need to have a drab kitchen when there are an almost endless variety of materials—tile, vinyl wallpaper, plastic laminates and even paneling that looks like wallpaper—to work with

BECAUSE THEY HAVE so much in common, kitchen counters and walls must be carefully coordinated with pleasing color schemes for best effect. Counters and walls are usually near each other, and certain kitchen wall areas can be considered to be functional extensions of adjacent counters.

Kitchen counters are used more than any other part of the room, so choose the materials of construction very carefully, considering the pros and cons of all available materials such as laminated plastics, linoleum, vinyl, ceramic tile, marble, stainless steel and hard maple.

To this list of traditional counter materials add something that is relatively new: glass-ceramic. This material will not burn, scratch or stain. It may be especially appropriate for some or all counters if you plan to install one of the newer types of ranges having completely smooth glass-ceramic tops.

Chances are that your choice will become a tossup between laminated plastic and ceramic tile. Both are easy to keep clean, and very durable. Perhaps the outstanding differences are that tile is more resistant to abrasion and heat while plastic is quieter and less likely to break glassware.

Give some thought to installation costs. You may be able to lay your own plastic laminate, but might feel that tile-laying should be left to a professional. Compare the relative materials and labor costs before deciding which material to use.

There is no reason why you should use only one type of counter material. You might put plastic or tile on most of the counters and still make the primary food-cutting and preparation section of hard maple. This should be near the sink in most kitchens, although it might also be ideal for an island counter. A wood counter, besides being highly functional, could help give your kitchen a truly distinctive look.

When you design your counters, avoid following blindly the almost instinctive inclination to simply follow the basic shapes of the cabinets on which they rest. In most cases this means straight edges and square

wall, garden: see masonry
wall, gypsum: see wallboard
wall paneling: see panels
wall planters: see brickwork
walls, plaster: see patching

corners. Examine your counter layout critically before completing your plans because there may be good reasons to introduce some curves into the counter edges—for both esthetic and safety reasons.

For example, you might have a standard-depth counter in the primary work area of the kitchen; this same counter might become narrower in another area of the room in order to make more space for a dining table and chairs. A sharp cutback will create a sharp corner that could be especially hazardous to small children running about the kitchen. If the transition from the wide to the narrow section of the counter consists of a continuous curve, bumped heads are likely to suffer less damage than they would on sharp corners. The curves are also easier on the hips of parents.

This is not to argue that all sharp corners should be eliminated. For safety reasons they should be done away with where the counters have unexpectedly abrupt changes in shape, as in the example cited.

Consider also what materials should be

▲ *Merry sunshine bathes this kitchen year-round. A lovely floral wall covering transforms kitchen and walls to a spring garden. It's vinyl-coated and fabric-backed for toughness and scrubbability. Unlike paint, which needs a face lifting, these flowers stay bright.*

◀ *This kitchen was rearranged for efficiency: twin wall ovens permit roasting and baking at the same time. The cooktop is handsome and easy to clean. Wall behind cooking counter was surfaced with 1 3/8-inch tile gems glazed in shades of red. This adds spice to color scheme, is easy to clean.*

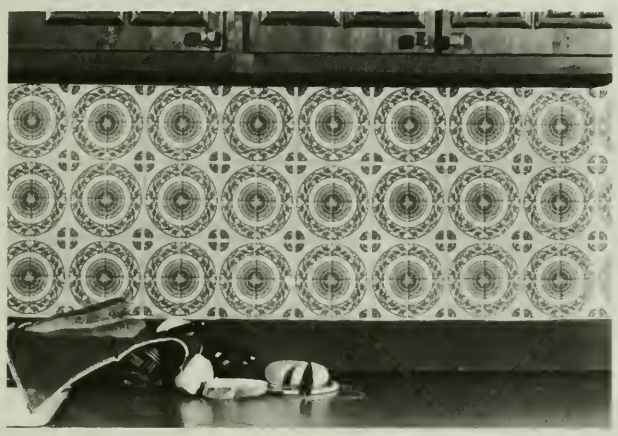
Produce plus plaid is the theme of this wall covering. Besides being bright and colorful, this vinyl-coated surface is strong, shrugs off soil and stains. A damp sponge takes care of it.

used for splash panels on the walls behind the sink and range. Here again the choice is likely to narrow down to plastic laminate and ceramic tile. If you are making minor improvements in a kitchen that already has a wholly serviceable plastic counter, you may have trouble finding matching plastic laminate for use as splash panels. A plastic laminate design that was popular ten years ago may have gone out of style and be hard to come by now. In this case you may have added reason to think about using ceramic tile for the splash panels.

Whatever you use, be sure that it is of material that is easy to wipe clean. Rough brick or stone may be fine in some areas of a kitchen, but of doubtful value in those areas where spattering grease or dirty water can get on them.

Wall materials. Paint is still the least expensive and easiest to apply material for kitchen walls. The main advantage of paint is that you can change the color scheme at any time at small cost and effort. Paint may also be a good "temporary" wall covering if you can't make up your mind about other types of materials, or if your budget is strained. By painting the walls, you can live with a chosen color scheme until you know for certain whether you like it or not. Later on you can switch to other wall coverings while still retaining the same basic color mood.

Greenwich Village is from a collection of murals. Highlighted is Washington Square, key-noted by representative shops, ways-of-living, even an outdoor cafe, topped by brownstones, midi-sized high-risers. Set consists of 8 panels.



Self-adhesive tiles in the latest design and colors.

Kitchen charm isn't hard to come by if you put something with bounce on those walls. Stylized mushrooms, apples and oranges are bound to cheer up the room. Vinyl-coated, it resists stains and soil, wipes off with sponge.

Wallpaper is also easy to apply and wholly practical if you choose the type that can stand repeated cleaning. Even vinyl upholstery fabric can be used on walls to provide a very practical and decorative surface.

Sometimes brick or stone can be used on one wall to add a very pleasing textural contrast to other walls. Just keep such rough materials away from the primary work areas. If real brick or stone is too expensive, consider the simulated plastic counterparts. These materials are in sheet form, and very easy to apply to any existing wall.

Wood walls that either match or contrast with the kitchen cabinets can be very smart. Prefinished paneling has a tough, easy-to-maintain surface. Bear in mind that if you elect to use dark woods, you may need more illumination to keep the kitchen from looking gloomy.

If you think that ceramic tile is passé as a kitchen wall covering (except as small sections behind the stove and sink), think again. There was a time when decorators shied away from tile on the grounds that it gave a kitchen too much of a hospital-like

sterile look. This viewpoint has tended to obscure the fact that the tile industry has developed hundreds of different tile colors and textures. You can achieve virtually any desired color scheme using modern tile. The main consideration is cost. To tile all or most of a kitchen can be quite expensive both in terms of material costs and labor.

Perhaps you would like to add tile to areas near the sink and range, but hesitate calling in a tile man to do the job. You may obtain a wholly adequate tiled effect by using plastic tiles that can be purchased in small quantities from the hardware or housewares sections of large department stores. These are easy to apply by anyone, and quite inexpensive.

Color sense. Whether you paint the kitchen walls, or finish them some other way, a harmonious color scheme must be obtained if the kitchen is to be an esthetic success. If you buy prefinished, ready-made cabinets, coordinate the wall colors with these. If you construct your own cabinets, or buy unfinished modules, you have somewhat more flexibility in working out an intergrated color scheme.

You are probably already familiar at least in theory, with some of the basic psychological effects of color. A small room can be made to look larger by the use of light colors; conversely, an overly large room will appear smaller if dark colors are used. Perhaps you do not want to "shrink" the room in all directions, only from the top down if the ceiling is too high. In this case put darker tones into the ceiling than you have on the walls. Another rule-of-thumb is to use warm colors in a cool room (as on the north side of a house), and cool colors in a warm, sun-lit room (especially in hot-climate areas).

Picking just the right color combination can be difficult for many people. Here are some basic rules that may prove helpful:

1. A one-color room can be attractive if the same color is judiciously varied from light to dark shades, and if contrasts and accents are emphasized by employing different surface textures.
2. In a two-color room, one of the colors should dominate by about 66 per cent. Since bright colors tend to emphasize their mutual color brilliance, use muted shades in order to avoid garish effects.
3. A three-color room is perhaps the trickiest to plan. One color should dominate, as in the two-color system. Most of the

Add zest to any room. The strawberries and stylized flowers of this vinyl wall covering provide a splash of color to an otherwise drab kitchen. It's scrubbable, stain-resistant and really tough. Do-it-yourselfers will appreciate the fact that it's ready-pasted, dry-strippable.

remaining surface should be covered with the second color. Use the third color only for accents.

These guidelines indicate how the colors should be proportioned. But that still leaves the ticklish problem of choosing the actual colors to be used.

Here's a hint that may help if you are not a color expert: Obtain as many color samples as you can from the local paint store, then head for a large department store. Study the merchandise in the drapery, carpet and clothing sections of the store for pleasing one, two-, and three-color combinations. When you find something that really pleases, use the paint-store color chips to pick out those colors that match the merchandise colors most accurately. In this way you can obtain the "advice" of professional color experts without paying a cent for their services and time.

This may not be an absolutely foolproof means of deciding on a harmonious color combination, but it surely is far more reliable than an off-hand by-guess-and-by-gosh decision. J.H.

See also: ILLUMINATION; KITCHENS; LAUNDRY ROOMS; PAINTING, HOUSE; PANELS; PARTITIONS; TILE, CERAMIC; WALL COVERINGS.

Add an eye-catching, up-beat look. One of the designs from a fabric-backed vinyl wall covering line comes in pre-trimmed, 27-inch width that is easily applied.

Capture the look of wallpaper in prefinished plywood paneling. The delicate pattern is easy to install, resists stains and can be cleaned with a damp cloth.

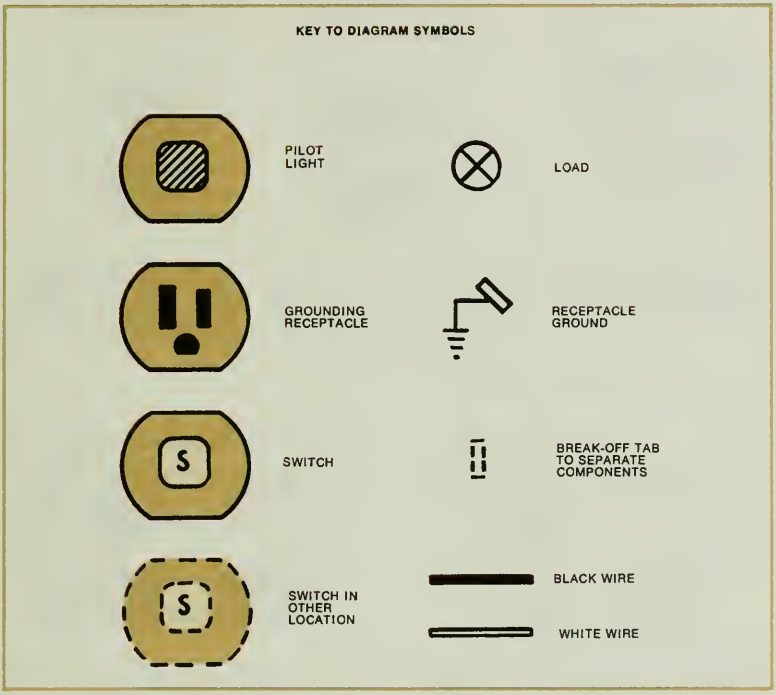
How to Select Combination Electrical Switches

There's a switch for every electrical purpose. Use this guide to find the switch that meets your wiring needs

MANY DIFFERENT COMBINATIONS of switches, receptacles and pilot lights are on the market. All are easy to install and wire, so why not use them to make your electrical system safer, and to provide step-saving convenience at the same time. The diagrams, which are largely self-explanatory, may suggest applications that might otherwise not come to mind.

First, study the diagram symbols. Note

wankel engine: see automobile engines, advances in
wankel engine tune-up: see tune-up, engine
wankel, mini: see rotary engine, mini
wardrobe: see furniture, indoor

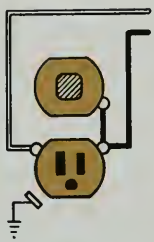


that two switch symbols are indicated. Switches drawn in solid lines are those combined in the same unit with another switch, receptacle or indicator light. A switch indicated with dashed lines represents a three-way switch in some other location; for example, at the end of a flight of stairs.

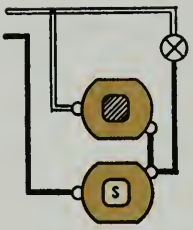
The load is generally assumed to be a light; however, it may also be a receptacle, a motor, or some other device using electrical power. Only grounding receptacles are indicated. These have a separate grounding terminal—usually marked with green paint —to which a short round wire is attached; the other end of the wire is attached to the receptacle box by means of a screw or bolt.

Some combination devices have a break-off tab between the two halves of each unit. In certain applications this tab is left untouched; in other applications it must be removed (pull off with pliers) in order to break the internal electrical connection between the two sections. *Caution:* Be sure to connect the black and white wires of your house circuit as indicated to preserve proper grounding.

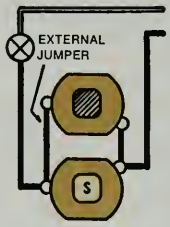
Indicator lights. When hooked to a receptacle, the light will remind you that a plugged-in appliance is operating. An indicator light may be used either as a pilot light (glows when the switch is ON), or as a night light to aid in finding the switch in the dark (glows when the switch is OFF).



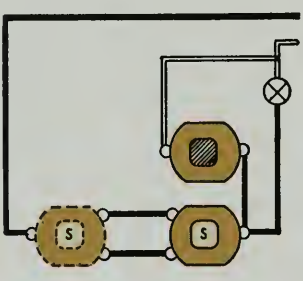
Receptacle with pilot light. The pilot light glows when appliance is plugged into receptacle and warns that current is on.



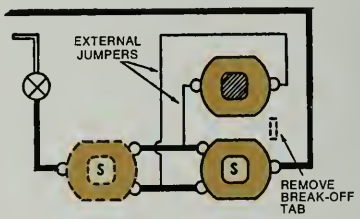
Pilot light with single pole switch. The pilot light glows when the switch is on and indicates if an out of sight load is functioning.



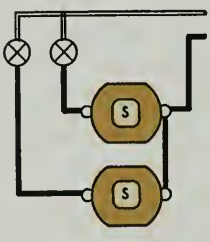
Night light with single pole switch. Light glows when switch is off. This is useful for making the switch easy to find in the dark.



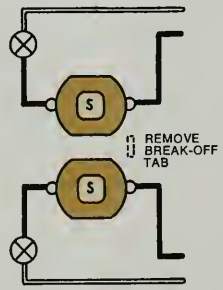
Three-way switch with pilot light. The pilot light glows when the switch is on. Two switches control out of sight lights, or some other electrical load.



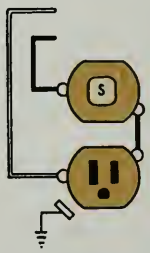
Three-way switch with night light. Indicator light glows when both switches are off. Break-off tab is removed to isolate the switch from lamp.



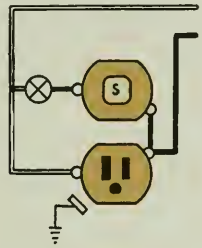
Two single pole switches on a common circuit. Even though both of the switches are on the same feed circuit, each switch controls independent lamps.



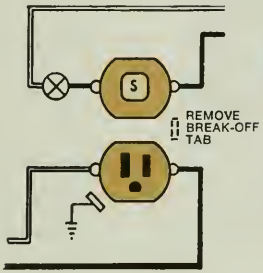
Two single pole switches on separate circuits. Each switch controls independent lamps. Remove break-off tab.



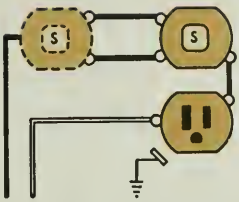
One single pole switch with grounded receptacle. Grounded outlet is on the same feed circuit as the switch and is controlled by the switch.



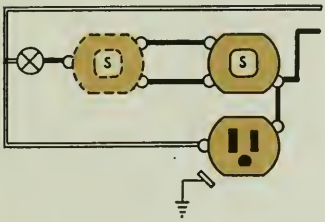
⚠ *One single pole switch controls light only; the grounding receptacle is not controlled by switch.*



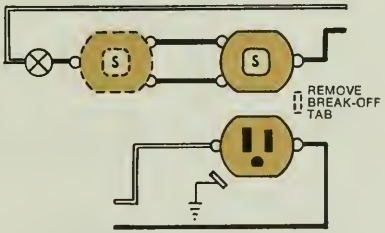
⚠ *One single pole switch controls light only; grounded receptacle is on completely separate circuit.*



⚠ *Grounded receptacle with three-way switch. Receptacle is controlled by the two separate switches.*



⚠ *Three-way switch and independent grounding receptacle. Switches at two locations control light only. The receptacle can be used independently of the switches.*



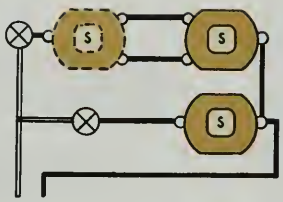
⚠ *Three-way switch and independent grounding receptacle. Receptacle is on a separate circuit, switches at two locations control the light only. Break-off tab is removed.*

Garage and attic light switches should have pilot lights so that lights will not be left burning unnecessarily in these areas. The indicator lights may also be incorporated into three-way switching circuits controllable from two different locations. Note that when the light is used as a night light in a three-way circuit, the break-off tab must be removed.

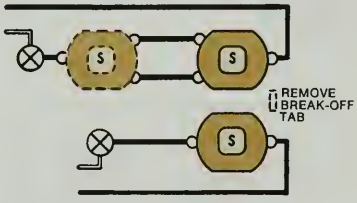
Two single pole switches. Combination single pole switches can be wired to operate independent loads. In one case the same feed circuit provides power for both switches and loads. To prevent overloads, each switch may have to operate from a different branch feed circuit. In this case remove the break-off tab, and wire as shown.

Switch and receptacle combinations. A single pole (SP) switch in combination with a grounding receptacle may be used to control the receptacle, or to control some other remote load, leaving the receptacle unaffected by the switching action. The receptacle may be on the same feed circuit or it may be on an independent feed circuit (remove break-off tab).

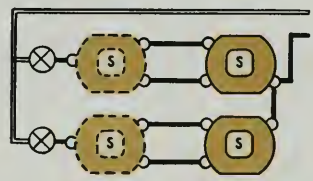
A similar circuit can use three-way



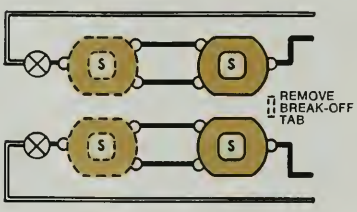
Single pole and three-way switches on one circuit. Three-way switches control one light, single pole switch controls the other.



Single pole switch is on one circuit, three-way switches on separate, independent circuit.



Two three-way switches on the same circuit. Each light is controlled independently by one of the pairs of three-way switches.



Two three-way switches on separate circuits. Each light is controlled independently by one pair of three-way switches.

switches. In each case the combination switch and receptacle is indicated with solid lines; a remote three-way switch is indicated with dashed lines.

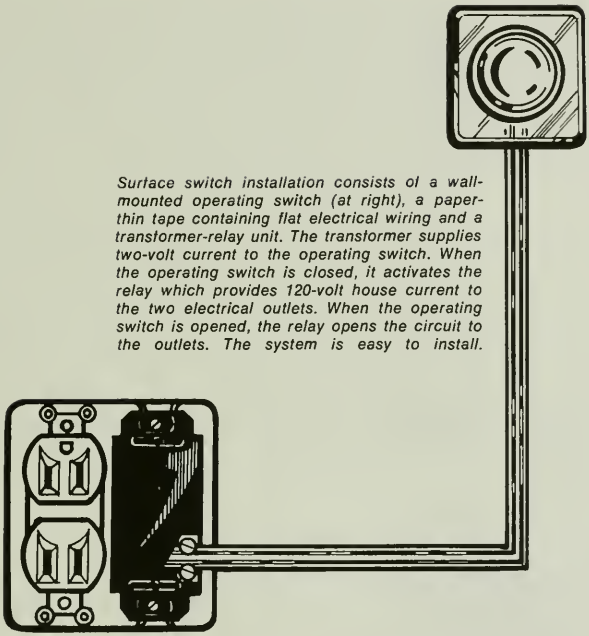
SP and three-way switches. It may be convenient to put a single pole switch and a three-way switch into the same box. Such combination switches are wired so that each switch operates a different load. In one case, both switches and loads use the same feed circuit. In the other case, each switch and its load uses a circuit different from that used by the other switch and load.

Two three-way switches. Two three-way switches in combination may be wired so as to either use the same or a different feed circuit. In each case, the switches operate independent loads. Switches indicated with dashed lines are three-way switches at some other location.

Check specifications. It is assumed that most of your combination devices will be used on 120-volt AC lines fused for 15 amperes. If you are working with higher voltage or amperage circuits, or if you are concerned with DC circuits, be sure that you purchase combination devices specially designed for such applications.

All of the combination devices considered here are also available with keyed locking switches. These switches can only be operated with a removable key. They are excellent in certain applications, as in a workshop equipped with power tools, to prevent unauthorized persons from turning on the circuits.

See also: ADDITIONS, HOME; CIRCUITS, ELECTRICAL; DIMMER, LIGHT; ELECTRICITY; HOME IMPROVEMENT; HOME OWNERSHIP; REMOTE CONTROL SWITCHES; WIRING, ELECTRICAL.



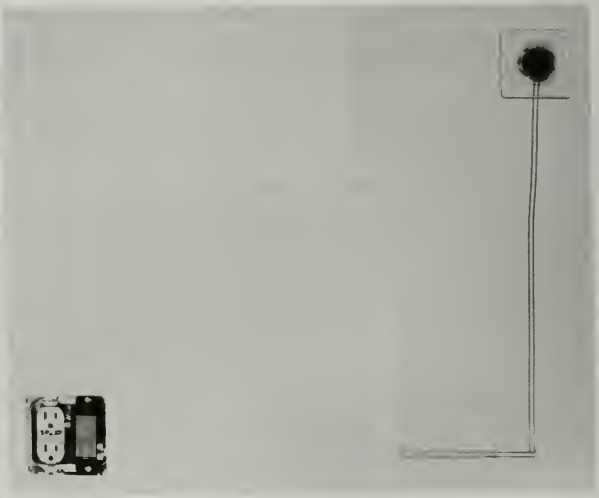
Surface switch installation consists of a wall-mounted operating switch (at right), a paper-thin tape containing flat electrical wiring and a transformer-relay unit. The transformer supplies two-volt current to the operating switch. When the operating switch is closed, it activates the relay which provides 120-volt house current to the two electrical outlets. When the operating switch is opened, the relay opens the circuit to the outlets. The system is easy to install.

How to Use Surface-mounted Electrical Wiring

You can use this handy two-volt tape to install remote control switches for almost any household electrical device

YOU CAN INSTALL a remote control switch that will activate a baseboard outlet or an electrical fixture, or any other device in your house without the expense, mess and trouble of running new wiring through walls or floors.

The trick is to use a relay system that consists of a low-voltage switch, a paper-thin tape containing flattened strands of electrical wiring, and a relay and transformer that activate or deactivate the house current in the outlet or fixture.

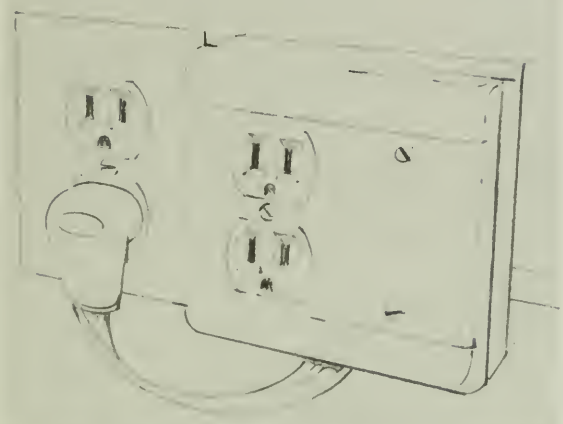


Surface switch installation, showing wiring tape partially concealed by first coat of paint.

Surface switch installation with wiring completely concealed with two coats of paint. The tape is not visible.

The conductive tape is so thin (five thousandths of an inch) that it can simply be run along a wall, ceiling, baseboard or door jamb and be concealed by two coats of paint. You just peel off the protective paper layer to expose the adhesive and apply it to the surface.

Suppose, for example, you have a lamp



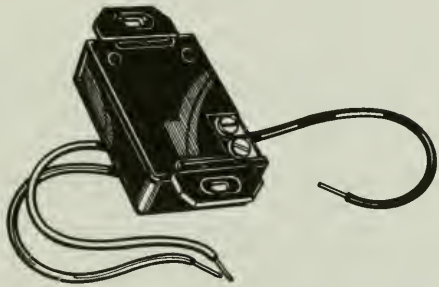
A simple do-it-yourself surface switch unit (right) plugs into ordinary household outlet.

The transformer-relay unit of the surface switch system. It can also be installed in lighting fixtures and other electrical devices for remote control from a wall-mounted switch.

at one end of a room and would like to be able to turn it on or off with a switch near a door at the opposite end of the room.

It's easy. The first step is to replace a double-gang outlet with one containing the transformer and relay. Then, run the wiring tape from the new outlet containing the transformer and relay to the place where you want to install the operating switch. Install the switch and the system will be in operation. The switch mounts easily on the wall, either with adhesive or with two small screws. All that remains to be done is to paint over the wiring tape.

The system works like this. The new outlet you installed contains a transformer—to step the house current down to two volts for the thin wiring tape—and a relay. When you close the two-volt circuit by operating the wall switch, the relay in turn closes the circuit that supplies 120-volt house current to the outlet. When the two-volt circuit is opened, the relay opens its circuit and the outlet receives no current. If you plug a lamp, an air conditioner, a sound system, or anything else into the outlet and leave it



turned on, it will be off when the wall switch is off and on when the wall switch is on.

The equipment is on the market and it includes a variety of fixtures, including equipment that will operate from a remote thermostat, and a combined outlet, transformer and relay that plugs into an ordinary outlet. Just mount the surface switch outlet next to the standard outlet and plug it in.

See also: CIRCUITS, ELECTRICAL; DIMMER, LIGHT; ELECTRICITY; REMOTE CONTROL SWITCHES; WIRING, ELECTRICAL.

How to Repair Your Automatic Washing Machine

Except for the gear box, you can repair or replace most of the parts yourself—with a big saving in expensive calls by the repairman

YOUR AUTOMATIC WASHER is designed to wash, rinse and extract water from clothes automatically. It should remove soil from most fabrics quickly and completely. It should retain the maximum whiteness in white clothes and it should not appreciably alter the shades of color in other fabrics. It should destroy bacteria that may be harmful to health when used with a recommended water and cleaning aid. Of course, the machine must be installed correctly and in proper mechanical condition.

Installation. Proper installation will do much to insure correct operation of the washer. Some minimum requirements are:

1. Proper electrical supply. A nominal 120-volt 60-Hz, 15-ampere fused electrical supply at a 3-pronged grounded receptacle is required. It is recommended that this be a separate circuit serving only the washer. Do not use an extension cord!
2. Proper water supply. Threaded faucets on hot and cold water supply lines located within 5 feet of the water inlet on the back of the washer. A minimum pressure of 10 PSI and a maximum of 100 PSI dynamic is recommended. Best washing results are obtained when the hot water temperature is between 140° and 160°F at the washer.
3. Proper drainage facility. The drain hose must empty into a tub or a standpipe at least 34 inches above the floor on which the washer is placed. This height must not exceed 72inches. The tub should have a 20-gallon capacity, and the standpipe should be about 2 inches in diameter.
4. The floor should be solid and the machine set level. Leveling legs are provided on washers for this.
5. All shipping materials must be removed from the machine.
6. The drain hose must be routed to the tub or standpipe in such a manner that it is free of twists or kinks. The end must fit loosely into the drain pipe to provide an air gap.

washers: see plumbing
water heater: see heating systems, home
waterproof finish: see lumber
waterproof sleeping bag: see camping equipment
water safety: see safety, water

Failure to provide an air gap will allow the water to siphon from the tub.

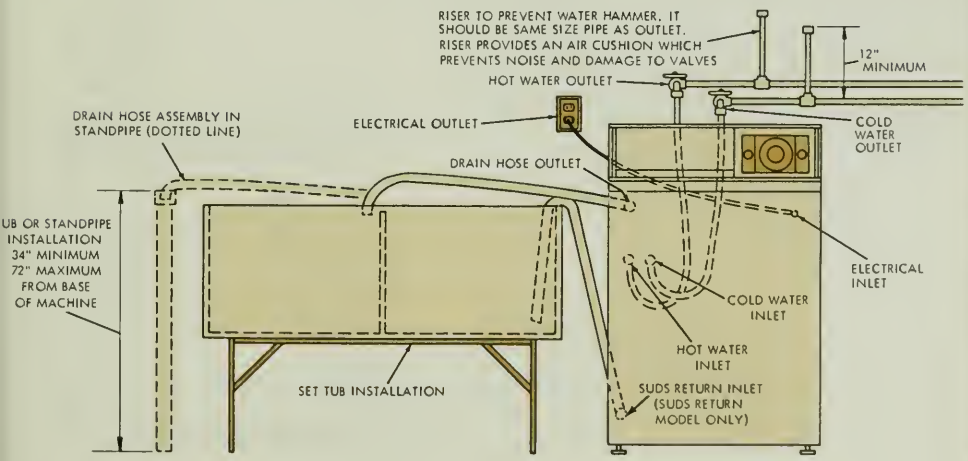
7. When connecting the fill hoses, make certain the screen washer is at the faucet end and the flat washer at the machine end. Screw the couplings on straight making them finger tight. Then tighten about ¼- to ⅓-turn with a pair of pliers. Do not overtighten. Make certain the hot water faucet is connected to the hot water valve on the machine; and the cold water faucet to the cold water valve.
8. After setting the machine in its permanent location, check it for being level. One method is to run water into the washer until it reaches the first row of holes in the basket. It should be level all around. Adjust the leveling legs until it is; then tighten the leg lock-nut.
9. If the electrical outlet is not properly grounded you must connect a grounding wire from the washer to a cold water pipe. This can be fastened under a screw on the back of the machine and to a ground clamp at the pipe. This is an important safety precaution to prevent the user from getting a shock that may be fatal if something happens to the electrical circuit.

Operating principles. The two basic washing actions are:

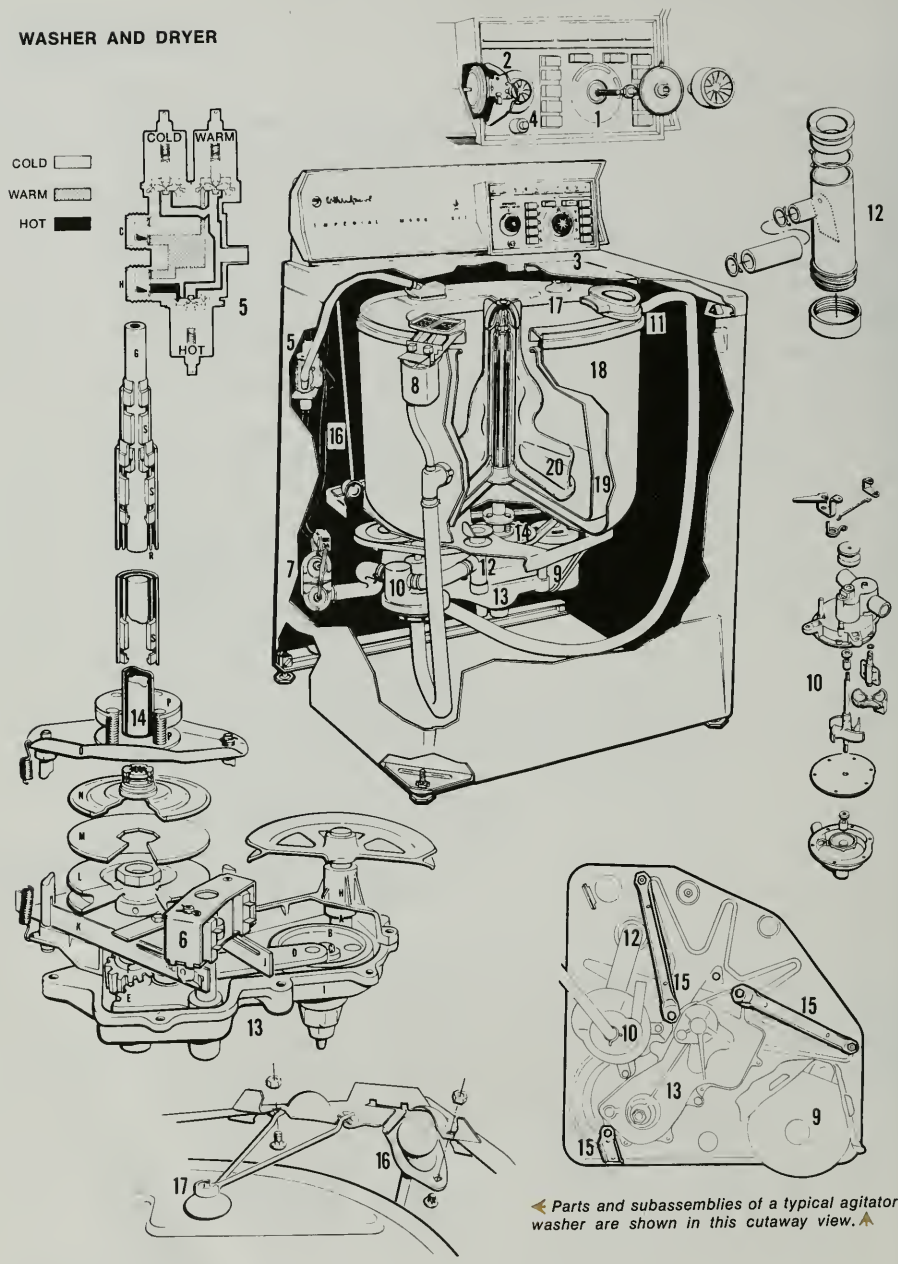
1. A reciprocating agitator mounted on a vertical shaft swirls water and clothes back and forth in a round tub.
2. A rotating drum mounted horizontally, or at some small angle above horizontal, picks up the clothes and drops them into a pool of water.

Both actions require proper water circu-

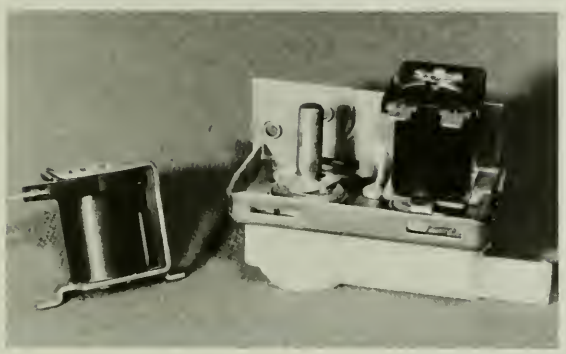
A typical washing machine installation. This machine has an optional suds return system. Note that the drain standpipe or tub top must be no higher than 72 inches from the floor and no less than 34 inches.


RISER TO PREVENT WATER HAMMER. IT SHOULD BE SAME SIZE PIPE AS OUTLET. RISER PROVIDES AN AIR CUSHION WHICH PREVENTS NOISE AND DAMAGE TO VALVES
12" MINIMUM
HOT WATER OUTLET
DRAIN HOSE ASSEMBLY IN STANDPIPE (DOTTED LINE)
ELECTRICAL OUTLET
COLD WATER OUTLET
DRAIN HOSE OUTLET
UB OR STANDPIPE INSTALLATION 34" MINIMUM 72" MAXIMUM FROM BASE OF MACHINE
ELECTRICAL INLET
COLD WATER INLET
HOT WATER INLET
SET TUB INSTALLATION
SUDS RETURN INLET (SUDS RETURN MODEL ONLY)

WASHER AND DRYER



Parts and subassemblies of a typical agitator washer are shown in this cutaway view.



All water fill valves are constructed so that the solenoid coils can be replaced without disturbing the plunger and valve assembly. In this illustration, one solenoid has been removed and the other left in place. Removal of more screws will allow disassembly of the rest of the valve. If the water is very hard or contains iron, the valve may have to be cleaned occasionally. Make certain the valve diaphragm bleed holes are clear of foreign matter.

REF. NO.	PART NAME	QTY.
1	Timer assembly, complete	1
2	Pressure switch	1
3	Spin switch	1
4	Light switch	1
5	Water inlet mixing valve	3
6	Control magnet	1
7	Two-way valve	1
8	Dispenser	2
9	Motor—1/3 hp 2-speed capacitor	1
10	Uni-directional pump	1
11	Filter	1
12	Tub outlet	1
13	Gear case assembly, complete	1
14	Basket drive and brake assembly, complete	1
15	Baseplate braces	3
16	Suspension	1
17	Snubber	1
18	Outer tub	1
19	Basket	1
20	Agitator	1

REF. NO.	INDIVIDUAL PART
13A	Pinion
13B	Main drive
13C	Eccentric
13D	Connect in rod
13E	Sector
13F	Agitation gear and spring
13G	Agitator shaft
13H	Cover
13I	Gearcase
13J	Agitation cam bar
13K	Spin cam bar
14L	Pulley
14M	Clutch lining
14N	Drive disc
14O	Clutch yoke
14P	Brake assembly
14R	Spin tube
14S	Center post bearing and seals

The timer of every washing machine is a series of cam-operated switches turned by a clock motor. Every electrical control circuit is connected to the timer. The terminals are coded to match the wires. G-BK on the timer, for example, means green with a black tracer. BR is brown.

lation, amount and temperature as well as a detergent to free and hold the soil. In each machine the sequence of operations is controlled by a timer.

Controls. The location of controls will

vary from model to model, but the basic function of each part will be the same, regardless of make, model or location.

The timer is the brain of an automatic washer. It consists of a clock-type motor with a special drive mechanism that moves a group of cams in a series of steps or increments. Each timer stop may last 2 minutes. The cams open and close switch contacts controlling the electricity using parts as they are needed during the cycles.

The pressure switch is the water level control used in most washers to turn the fill valves off when the water has reached the proper height. It is usually mounted on the control panel, near the timer, and connected to the bottom of the tub with a plastic tube. As the tub fills, the weight of the water compresses the air in the tube until the pressure moves a diaphragm. This trips the switch to turn off the water valve and restart the timer motor.

Automatic washers that do not use a pressure switch allow a fixed period of time for the fill valves to be turned on during the fill cycle. These fill valves are special in that they include a flow control washer which meters the water flow rate into the machine.

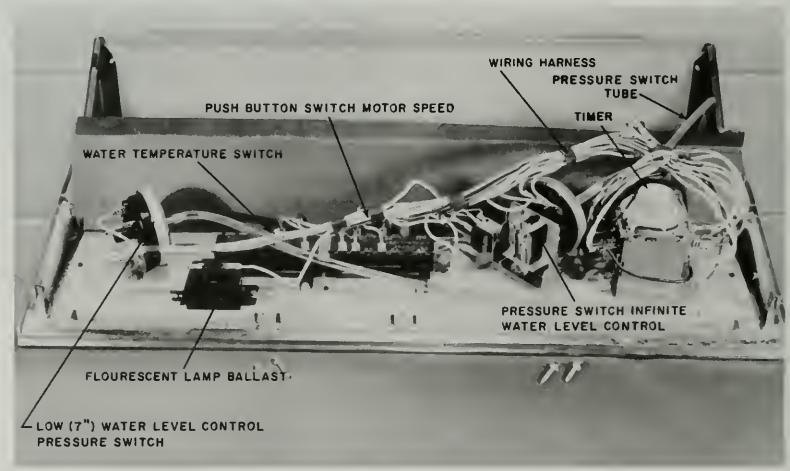
The water temperature control is a switch connected to the fill valves. It determines whether both the hot and cold valves or either one will turn on when the timer connects the fill cycle.

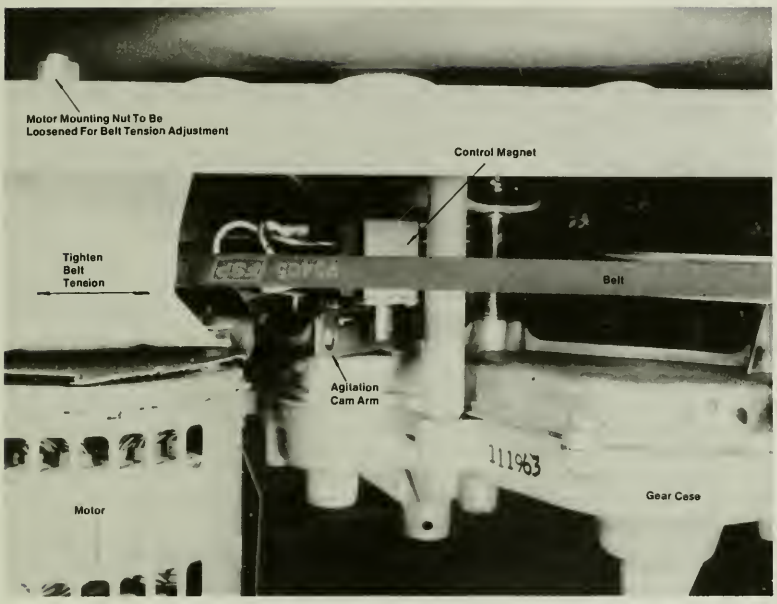
Workers. If you will consider the controls as mechanically operated electrical switches, then you must consider the workers as electrically powered devices used to do a mechanical job.

The fill valve is a pair of solenoid-operated pilot valves. One allows cold water flow and the other hot water flow. The water mixes in the valve body and exists through a common outlet into the tub.

The motor is usually a ½-HP, 120 V, 60 Hz, single-phase, induction type. It operates at about 1750 revolutions per minute. It drives the agitator during the

A washer control panel seen from the rear. This machine has two pressure switches, while most models have one. Some machines have three pre-set water levels. Others have variable levels from 8 to 11 inches of water depth.





Washing machine belt tension is usually adjusted by unloosening the motor mount and moving the motor. In this model, access to the motor for belt adjustment is through the rear cover.

wash cycle, the basket during the spin cycle, the recirculating pump during the wash cycle and the drain pump during the drain and spin cycles.

This much is essentially the same for all washers. Differences will be in the gear case assemblies and the various means used for taking the power from the motor and applying it. The change from one cycle to another is usually made by a solenoid coil which moves a plunger to shift the mechanical action.

A belt, or system of belts, is the most common method of transmitting power from the motor to the three major moving parts: the water pump; the agitator or slow-speed rotating drum; the high-speed spinning basket.

A slipping or loose belt is a common source of trouble. It should be the first thing checked if the motor runs and the machine does not operate properly. Most belt tension adjustments are made by shifting the motor more tightly against the belt and securing its fasteners.

The water system is divided into three sections: the fill system; the recirculating system; the drain system.

The fill system admits hot and cold water from the household plumbing to the tub. It consists of two hoses, two screens, the fill valve, fill hose and a boot with an air gap. The air gap is important because it prevents the suds from getting back into the household plumbing There is no connection between this system and the rest of the water system in a washer.

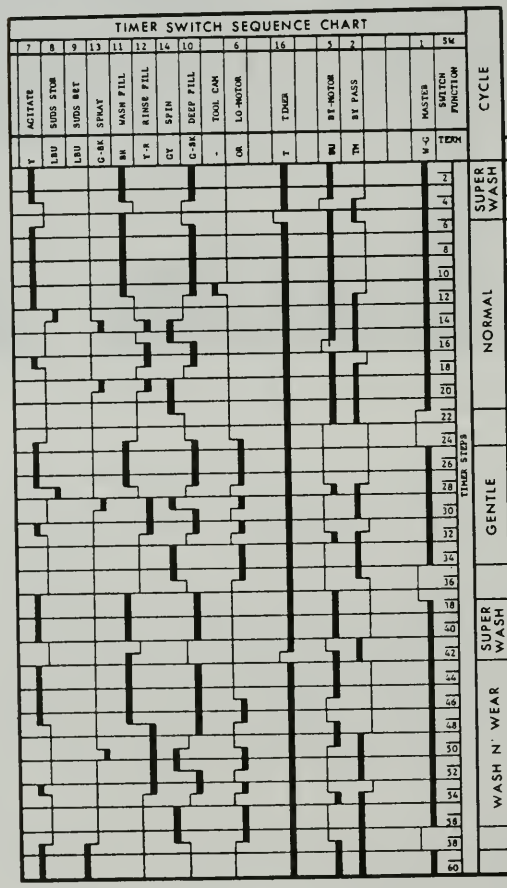
The recirculating water system consists of a pump and a filter connected to each other and the tub through a set of hoses. Water should always recirculate during the washing cycle.

WARNING DISCONNECT FROM ELECTRICAL SUPPLY BEFORE OPENING ENCLOSURE

AUTOMATIC WASHER WIRING DIAGRAM

- TIMER SWITCH
- INTEGRAL COMPONENT CONNECTION
- HARNESS WIRING
- TERMINAL CONNECTION
- MANUAL SWITCH
- AUTOMATIC SWITCH
- SPRAY SWITCH (OPERATION IS INTERMITTENT AND SEQUENCE MAY NOT BE SHOWN)

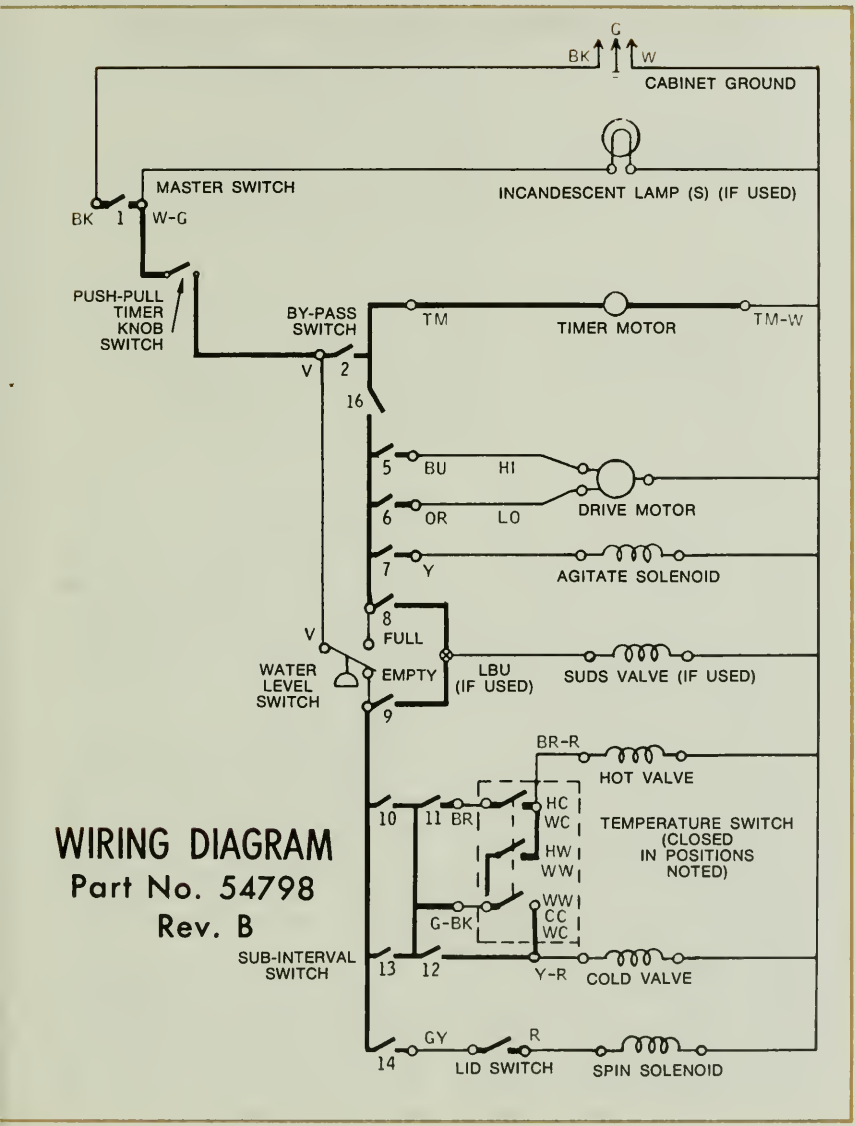
TIMER STEPS ARE 120 SECONDS DURATION



Timer No. 84148

CYCLE	MACHINE FUNCTION	
SUPER WASH	WASH-FILL	WASH-HI
		PAUSE
		DRAIN
NORMAL	WASH-FILL	WASH-HI
	SUDS STOR.	DRAIN
	SPRAY	SPIN-HI
	RINSE-FILL	RINSE-FILL
		RINSE-HI
		DRAIN
	SPRAY	SPIN-HI
	OFF	
GENTLE	WASH-FILL	WASH-LO
	SUDS-STOR	DRAIN
	SPRAY	SPIN-LO
	RINSE-FILL	RINSE-FILL
		RINSE-LO
		DRAIN
		SPIN-LO
	OFF	
SUPER WASH	WASH-FILL	WASH-HI
		PAUSE
		DRAIN
WASH N' WEAR	WASH-FILL	WASH-HI
		WASH-LO
	RINSE FILL	COOL DOWN
		DRAIN
	SPRAY	SPIN-LO
	RINSE-FILL	RINSE-FILL
		RINSE-LO
		DRAIN
		SPIN-LO
	OFF	
	SUDS RET	AGIT-HI

Every washing machine has a schematic diagram, usually on the back. The heavy vertical lines on the timer sequence chart here indicate the circuits that should be in operation at each timer step.



WIRING DIAGRAM

Part No. 54798

Rev. B

PRELIMINARY CHECK LIST

WASHER DOES NOT FILL IN WASH CYCLE	See if electric cord is plugged in correctly. See if the hot and cold water faucets are turned ON. Set timer control knob in FILL portion of wash cycle and push the control knob in. See if house fuse is blown. See that the water inlet hose filter screen is clean. To check: turn off water faucet; remove hoses and check for deposits of foreign material at screens; remove foreign matter present by flushing under running stream of water; replace hose connection over water faucet tightly; turn on water faucet and check for leaks. See that hoses are not kinked.
WASHER DOES NOT SPIN	See if lid is closed. See if electric cord is plugged in correctly. See if house fuse is blown.
WASHER SEEMS TO BE DRAINING DURING WASH AND RINSE CYCLES	Make sure open end of drain hose is higher than the water level in the washer; if hose is lower than the water level in tub, water will siphon out.
WATER WILL NOT DRAIN FROM WASHER	Check to see that drain hoses are not kinked. Make sure drain hose is no higher than 72 inches above base of washer.

The drain system is connected to the recirculating system using the same pump and some of the same hoses. Sometimes the pump has a diverter valve to direct the water flow from recirculate to drain. Other machines will reverse the pump to direct the water out the drain hose. The water must always be drained from the tub before the spin cycle starts. Draining must continue during the spin cycle to remove the water extracted from the clothes.

The electrical system. All automatic washers should have a wiring diagram and a cycle chart pasted on the back of the machine. The accompanying diagram for a typical washer shows how the timer is electrically connected to the other parts. The cycle chart shows which parts should be in use at any particular timer step. Study these carefully because only by knowing what is supposed to happen can you tell if the machine is doing what it should do at any given time. Then when you look for trouble, test those parts that should be activated.

An AC voltmeter or a 25-watt test light connected to the terminals of a working part will indicate whether or not it is getting power. An ohmmeter can be used to determine if a coil is defective.

General. We have not gone into detail on the transmission or gear box because any failure in that area will require special tools for assembly or disassembly. Each manufacturer uses a different approach to gear box design so it is best to leave that part of a service job to a well-equipped professional.

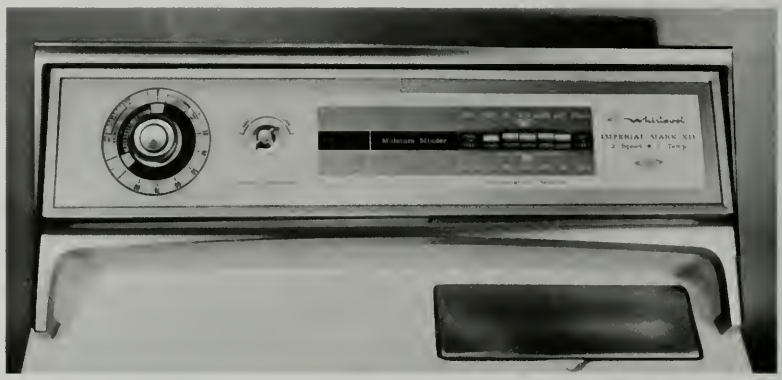
Belts, pumps, hoses, fill valves, timers, pressure switches and other electrical parts are usually available from the local dealer for your machine. None of these parts are readily repairable, except the pump and filter. (These may have jammed with a sock or a collection of lint.) Some of these parts —timers in particular—are available on a rebuilt and exchange basis at a saving in cost.

The accompanying Trouble-shooting Chart should serve as a guide in locating the general area that caused the problem. However, refer to the Check List before you get too involved with the machine itself. G.M.

See also: APPLIANCE REPAIR; ELECTRICITY; INDIVIDUAL APPLIANCE LISTINGS.

WASHING MACHINE TROUBLE-SHOOTING CHART

PROBLEM / POSSIBLE CAUSE	NO POWER TO FILL VALVE	SUPPLY TURNED OFF	KINKED HOSE	CLOGGED SCREEN	DEFECTIVE WATER LEVEL CONTROL	HOSES REVERSED	INADEQUATE HOT WATER SUPPLY	DEFECTIVE TEMPERATURE SWITCH	DEFECTIVE FILL VALVE	DEFECTIVE TIMER	DEFECTIVE HOSE	LOOSE HOSE CONNECTION	DEFECTIVE GASKET	DEFECTIVE PUMP	DEFECTIVE VALVE	MOTOR WILL NOT REVERSE	LOOSE BELT	FAULTY MOTOR	LOOSE WIRE OR CONNECTION	DEFECTIVE TRANSMISSION/CLUTCH	MACHINE NOT LEVEL	FLOORING WEAK	UNBALANCED LOAD	IMPROPER BLEACH USAGE	BROKEN AGITATOR	CLOGGED FILTER	WATER DID NOT DRAIN
NO WATER FILL	✓	✓	✓	✓	✓																						
INCORRECT FILL					✓		✓																				
INCORRECT TEMPERATURE							✓	✓																			
WATER WILL NOT SHUT OFF					✓				✓																		
WATER LEAKAGE			✓							✓	✓	✓	✓	✓	✓	✓	✓										
WATER WILL NOT DRAIN										✓					✓		✓	✓	✓	✓							✓
MOTOR DOES NOT RUN										✓	✓						✓	✓	✓	✓							
NO AGITATION										✓									✓	✓	✓				✓		
NO SPIN																			✓	✓	✓						
SLOW SPIN																						✓	✓	✓			
EXCESSIVE VIBRATION										✓												✓	✓				
MACHINE WILL NOT SHUT OFF											✓														✓		
TIMER DOES NOT ADVANCE					✓																					✓	
DAMAGES CLOTHES																											✓
NO WATER RECIRCULATION			✓															✓									



Dryer control panel. Small access door at right is for lint screen removal. To remove the top of the dryer, open the lint screen access door and remove two screws that hold the screen fixture in place. Then, merely pull the whole top forward and upward. It is hinged at the back.

How to Repair Your Clothes Dryer

This is a relatively simple appliance and, except for the burner in a gas dryer, you can do most of the work yourself

YOUR AUTOMATIC DRYER is not a very complex machine. It simply tumbles the clothes in a stream of warm air which removes the moisture from the clothes and blows it outside.

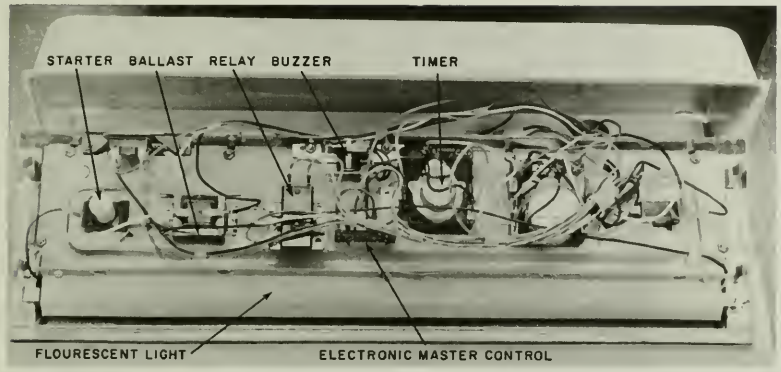
The tumbling action occurs in a revolving drum driven by an electric motor which also drives the fan that produces the air motion. The heat is obtained from either an electric heating element or a gas burner, depending on whether you have an electric or gas dryer. The drying time is controlled by a timer; the temperature by a thermostat.

Some dryers have an electronic sensor to control the degree of clothes dryness. In some models the electronic sensor operates with a timer and in others there is no timer.

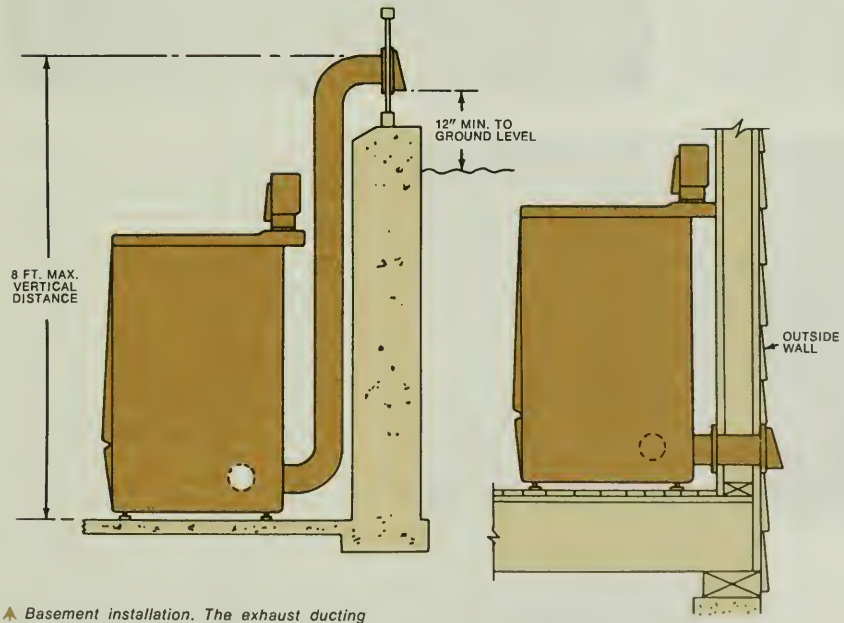
Most dryers have a wiring diagram posted on the back. Use it when you are looking for trouble.

Know what the dryer can do. Before doing any service work on a dryer (or any other appliance), read the owner's manual to familiarize yourself with the proper operation of the machine and its limits. You should know whether or not the machine has two tumbling speeds or if there is a cool-down period at the end of the drying time during which the clothes tumble. Don't blame the dryer for wrinkled permanent press clothes if they are allowed to remain in the dryer drum after it has stopped tumbling.

Normal operation of the dryer is reasonably quiet. Any random noises could be due to free moving hard objects being tumbled with the clothes; they must be removed. A lipstick could quickly ruin a load of clothes;

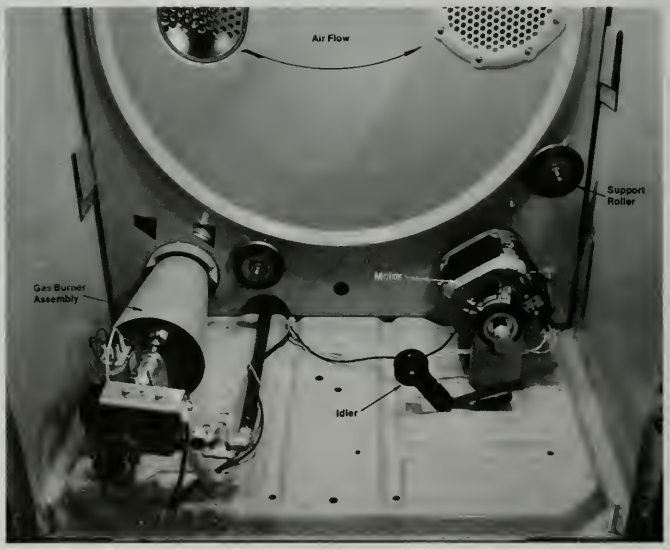


▲ *Rear view of the control console of a Whirlpool dryer.*

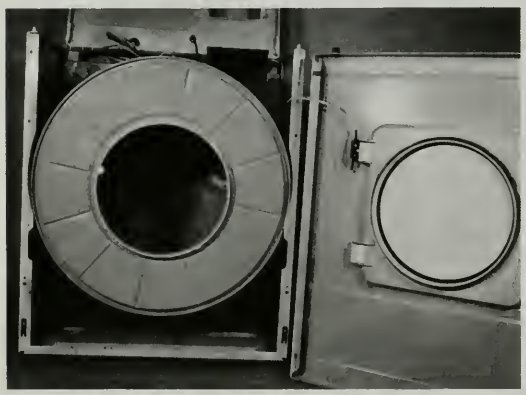


▲ *Basement installation. The exhaust ducting can be directed from the rear or side of the dryer through a basement window or wall above ground level.*

▲ *First floor installation. The exhaust ducting can pass from the rear or side of the dryer through the outside wall.*



➤ *Removing the drum makes it easy to get to the motor, support rollers and gas burner (in this model), or electric heating unit. While the drum is out, check the idler and support rollers for lubrication. They should turn freely, but do not overlubricate; excess oil will collect lint.*



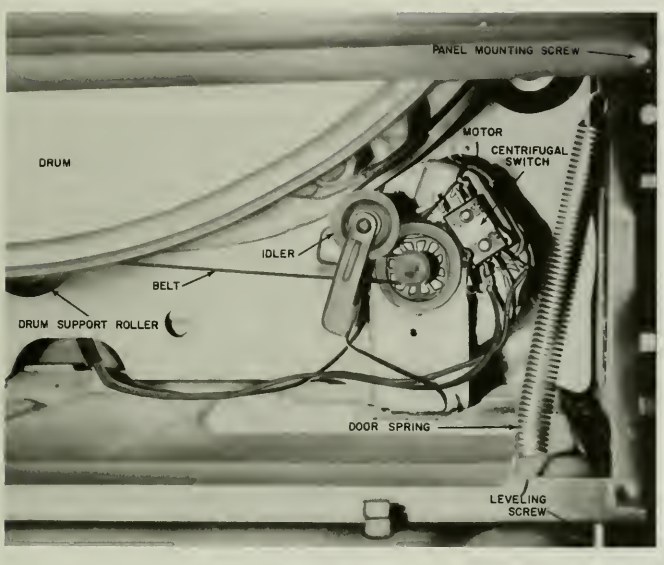
▲ *Dryer front can be removed easily, once the top has been lifted. Some models may have two screws near the top of the cabinet, while others may have six—two on each side near the top and one at each door hinge in models with drop-down doors. On all of these machines, the ring around the drum opening serves as a front bearing for the drum.*

bobby pins and nails could damage the drum or the electric heater element.

The air drawn through the machine is usually exhausted outside the house through a 4-inch duct. You should have some feel for the proper air flow for your dryer. Any decrease in air flow will indicate an obstruction in the duct. This may be due to an accumulation of lint in the system or failure to clean the lint trap. This lint filter should be cleaned after every load.

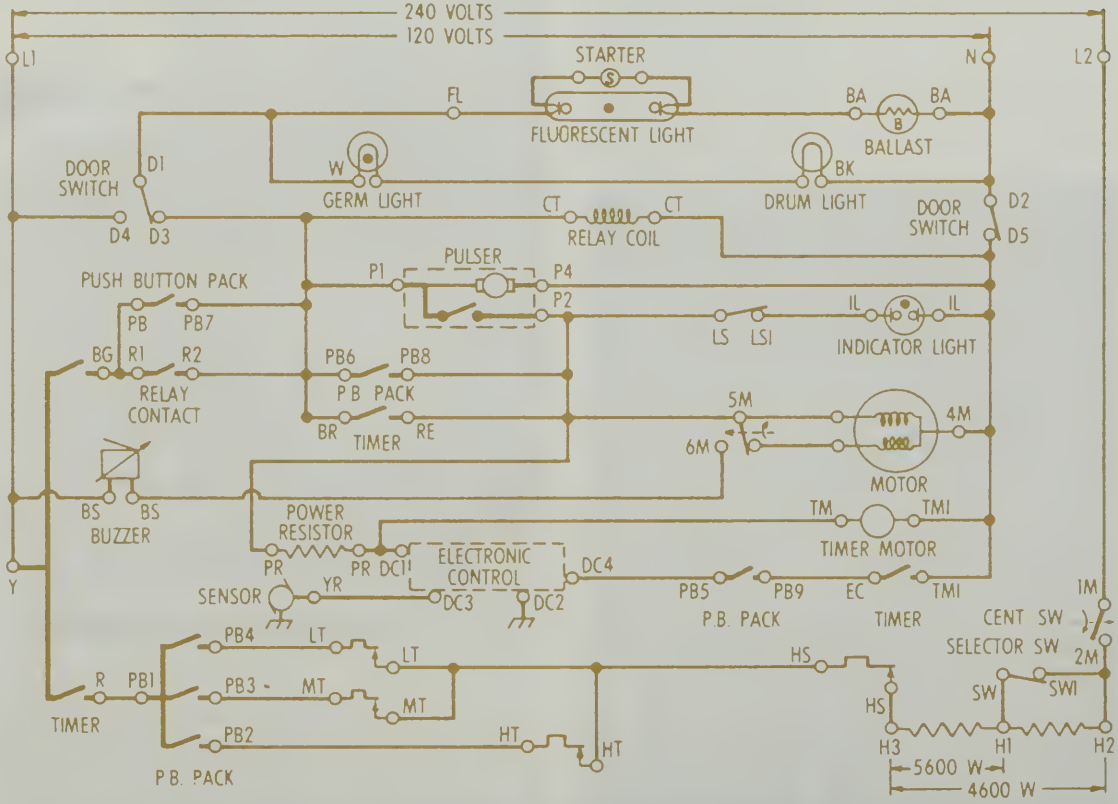
The installation should be close to an outside wall in order to keep the exhaust duct as short as possible. Long ducts decrease air flow and collect lint. The machine should be level and firmly set on the floor. Dryers are equipped with leveling screws which can be adjusted so that each leg is in secure contact with the floor. Most electric dryers must be connected to a 240-volt AC power source with a No. 10 three-wire cable protected by a 30-ampere fuse.

A gas dryer requires at least a 15-



Note the method of threading the belt through the idler carefully. The belt passes around the entire drum, which the motor turns at about 55 rpm.

An older model dryer with the back panel removed. Note the dangerous accumulation of lint, which must be cleaned out (use a vacuum cleaner) before the machine is serviced. The motor and fan assembly are accessible from the rear. The drum drive pulley is often held to the shaft with two setscrews, one locking the other in place, so don't try to force it off after removing only one screw.

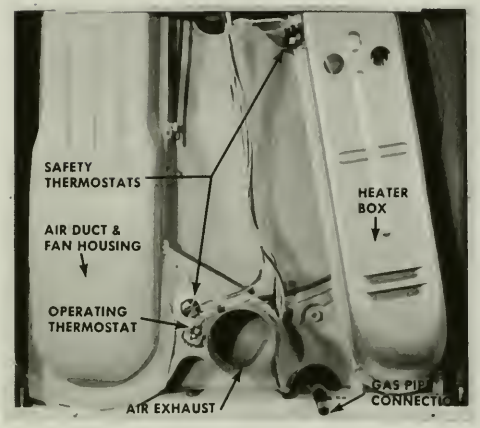


Most dryers have a wiring diagram attached to the back. Use the diagram for your machine while making tests.

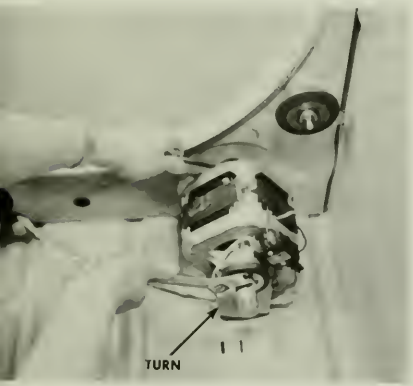
ampere, 120-volt power supply to operate its motor and controls; a 20-ampere circuit wired with No. 12 wire would be better.

A gas burner is typically rated at 25,000 B.T.U.'s and should be supplied by a ½-inch pipe if not over 20 feet from the meter. A longer run would require larger pipe. In either case there must be a gas shut-off valve near the dryer. If you have to do any work with a gas burner, make certain this valve is shut off. When reassembling the burner check the fittings for leaks with a soap solution. Any movement of soap bubbles would indicate a gas leak.

Service. Servicing the dryer may be done from either the back or the front, depending on the model. The back panel can be removed to expose the electric heater wiring, duct, thermostats and, on some models, the drive belts and pulleys. From the front, an access cover under the door can usually be removed to expose the gas burner, and in some models, the motor and belt drive.



Both electric and gas dryers have safety thermostats. These are located at the top of the heater box and the exhaust fan housing assembly. They are ordinarily closed and open only if a malfunction causes overheating.



Remove the blower wheel to service the motor. Remove it from the shaft with an 11/16-inch open-end wrench at the blower hub and an adjustable open-end wrench on the flat on the shaft behind the pulley. Hold the wrench stationary on the hub and the turn the shaft clockwise. The centrifugal switch can be removed, if necessary, without removing the motor from the machine. When replacing the motor, make sure that the dimple on the motor mounting hub mates with the slot on the support.

To replace a belt on these models it will be necessary to remove the front panel and top.

Removing the top on Whirlpool and Kenmore dryers involves removing the screws that hold the lint filter chute to the top and removing the lint filter, then pull the top forward and lift. It is hinged at the rear and can be folded back to lean against the wall. This will expose the door switch, its wiring and the screws that hold the front to the sides. After the front is removed the drum can be lifted out.

Anytime you work on a dryer, clean it out; remove the dust and lint. A vacuum cleaner does a good job on this.

Before servicing a dryer make certain that electricity is available at the dryer terminals. There must be 208 to 240 volts at the two outside terminals of an electric dryer and 120 volts from the center ter-

minal to either outer terminals. This test can be made with either an AC voltmeter or a test light consisting of two 120-volt bulbs connected in series. Make certain the dryer is turned off when making this test or else you may get a false reading. It is possible for a fuse to blow in one line allowing the motor and controls to work but there would be no heat.

A study of the wiring diagram will show that the heater circuit includes several safety switches and thermostats. The timer-operated switch controls the length of time the heater is on. The high limit or safety thermostat is normally on and turns off only when the exhaust air gets too hot. The operating thermostat cycles on and off to maintain a preset drying temperature. The centrifugal switch is operated by the motor and is ON only while the motor is running and the fan is moving air through the dryer. Thus, there are at least four controls in series with the heater element.

The motor is controlled by the timer and/or some other ON-OFF switch and the door switch. The motor will not start unless the door is closed.

Any electrical testing can be done with either a test light or a volt ohmmeter and a wiring diagram. Follow the diagram and test from point to point in an orderly and logical manner. The Trouble-shooting Chart will serve as a broad guide to locate an area in which to start looking for the problem. Any defective electrical part will have to be replaced. A loose or burned connection will have to be cleaned and tightened. Make certain that all wiring is secure so that it will not rub against a moving part or chafe its insulation on a sharp corner.

The gas burner. There are many different types of gas burners and automatic ignition methods. Each requires a different service approach and, in some cases, special tools and test equipment.

Clean and check the dryer for all other troubles, making certain electrical power is available to the gas burner. Then, if the burner doesn't operate, call a service technician who is qualified to work on your particular make of dryer.

See also: APPLIANCE REPAIR; ELECTRICITY; INDIVIDUAL APPLIANCE LISTINGS.

AUTOMATIC CLOTHES DRYER TROUBLE-SHOOTING CHART

PROBLEM \ POSSIBLE CAUSE	NO POWER	LOOSE CONNECTION	DEFECTIVE DOOR SWITCH	DEFECTIVE TIMER	DEFECTIVE MOTOR	DEFECTIVE HEATER ELEMENT	HEAT SWITCH "OFF"	DEFECTIVE THERMOSTAT	DEFECTIVE BELT	FROZEN BEARING	CLOGGED LINT SCREEN	LEAKY DOOR SEAL	CLOTHES TOO WET	INCORRECT CONTROL SETTING	CLOGGED EXHAUST DUCT	GROUNDED WIRING
WILL NOT RUN	√	√	√	√	√											
WILL NOT HEAT	√	√		√		√	√	√								
DRUM WILL NOT ROTATE									√	√						
WILL NOT SHUT OFF				√												
CLOTHES NOT DRYING							√	√			√	√	√	√	√	
TIMER FAILS TO ADVANCE		√	√	√												
BLOWS FUSES																√

How to Practice Water Skiing on Dry Land

You can familiarize yourself with the basic starting position for water skiing on the beach, or in your living room

Stand in the ski bindings and make sure they are adjusted to fit snugly, but not tightly. Wear your ski belt to make the practice session as much like real water skiing as possible.

WHERE'S THE BEST PLACE to learn to water ski? It's on dry land! A little time spent on skies on the beach, or even in your own living room, helps you to understand the basic fundamentals of the sport. You gain skill and confidence without even getting your feet wet. All you need are skis, ski belt, towrope, and a strong, healthy friend.

Sure, you're ashore and in no danger, but wear the ski belt; even experienced skiers use these, and you want to simulate the real thing as much as possible. Fit your feet firmly into the binders and do a few deep knee bends to loosen up your leg muscles and to help improve your sense of balance on the skis.

Next, sit down on the backs of the skis, knees against your chest. While your partner keeps a slight strain on the towline, hold the tow bar as shown in the photos. Note that the arms are straight out, and the tow bar is grasped with the palms of the hands facing down. Note, too, that when in the water, the tips of the skis will be pointing up slightly.

Let your partner pull you upright to the skiing position. Keep your feet flat in the

waves, light: see communications
waves, sound: see science projects
wax: see candle making
waxing floors: see floors
weapons: see reloading

binders, and let your legs do the lifting. Do not pull the tow handle in toward your chest; your arms should remain perfectly straight. Any tendency to pull with your arms should be corrected before you go out on the water.

In the upright position, your back should be straight, and the knees slightly flexed. Your legs must be kept rigid enough to keep the skis straight, but your knees must act as shock absorbers that react to waves. In this position, you should not fall backwards if the towline is suddenly released or dropped.

Repeat this entire procedure several times. Remember that you are in control; you signal your partner when to pull; as the pull increases, stand up, using your legs —not your arms. When erect, your arms and back will be straight, your knees bent slightly. When you feel that you have mastered dry-land skiing, you are ready for the water.

In the beginning, practice your starts from shallow water, where you can sit on the skis in the same manner as on dry land, but with the tips of the skis pointing up slightly. Have the boat ease forward until the slack is out of the line; signal the driver to apply power. You'll feel the same pull that you did on land, except now you

Sit on the backs of the skis (above) behind bindings with the knees against the chest and the arms straight out. This is the actual starting position in the water (right), although, in the water, the ski tips point up as the skier is pulled through the water.

As your partner pulls on the towline, use your legs, not your arms, to rise to an erect position. Keep your arms straight.

With your arms and back straight, come to a full standing position, with the knees slightly bent to absorb the shock of wave action against the skis.

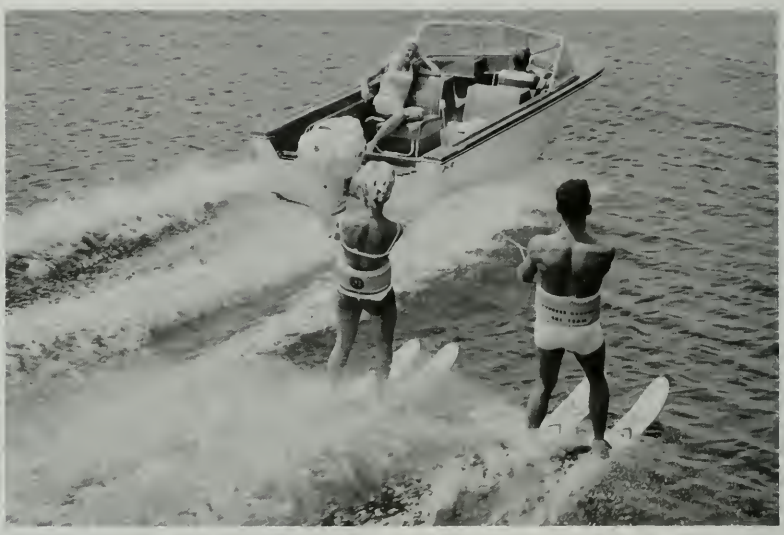
will be moving through the water. As power is increased, you will stand up—again, just as you did on land.

Don't expect instant success, because your movement through the water will introduce some new problems. It usually takes five or six tries before the average beginner is really up on the skis. One frequent error is to lean forward, causing loss of balance. Another error is to try to pull up on the towline to maintain balance, or to take up imaginary slack in the line. If you do pull, you create real slack! Your body is out-running the towline handle. This can be corrected by straightening the body, as well as the legs, in the initial standing move.

Once you're successfully up on skis behind the boat, you have to learn the easiest part of all: landing. Just let go of the handle and you will sink slowly off plane. Then you can swim to shore, or be picked up by the boat.

Once you have mastered the basic steps of getting up on the skis, maintaining your balance behind the boat, and making landings, you're ready to go on to the more advanced aspects of the sport. And it's not too difficult to master the basics if you do your initial practicing ashore. T.B.

See also: SAFETY, WATER; SWIMMING.



Rate Your Ability on Water Skis

If you wish, you can get a rating of your ability as a water skier from a national water ski association

HOW DO YOU RATE as a water skier? When you read about tournament skiers and see them perform, do you ever wonder just how well you would stack up with them?

Rating yourself as a skier is easier than you think, and getting an official rating is just as easy. Competitive water skiing has been organized by the American Water Ski Association on the basis of comparative skills, not unlike the handicap system in golf.

Six ratings have been established. One purpose of this is to match skiers of comparable skill in the three events of competitive water skiing—slalom, jumping and tricks—but the requirements for the various ratings also serve to indicate any skier, whether he contemplates tournament skiing or not, just how far he has advanced in the sport.

Let's take the first rating a skier must attain in the AWSA ladder of skills—the Novice rating. To pass this test a skier must be able to:

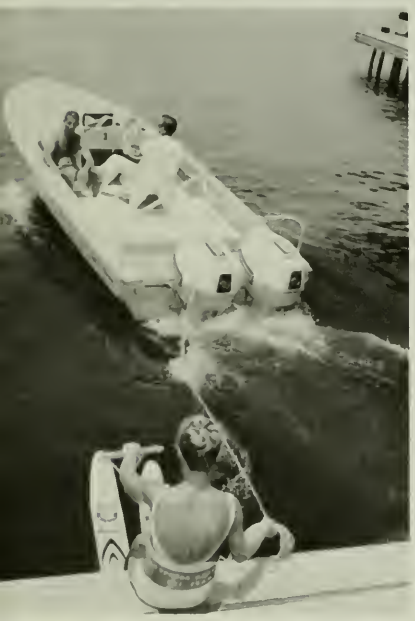
1. Make a "dry" start from the dock.
2. Put on skis and start in deep water.
3. Be able to ride one ski.
4. Cross both wakes of the towboat on two skies and return.
5. Coast to a stop without falling after releasing the towline.
6. Demonstrate a knowledge of skiing signals.

7. Exhibit a thorough knowledge of skiing safety rules.

If you would like to hold an official rating, you can obtain a rating card from the association and demonstrate your ability before an AWSA assistant rating judge or certified AWSA Regular Instructor.

Within organized skiing, judges are rated, too. An Assistant Rating Judge is required to have only minimum qualifications in skiing knowledge, but the higher ratings—Assistant Judge, Regular Judge and Senior Judge—are much more demanding and call for tournament work in order to be retained from year to year.

The next rating for skiers is Third Class. This rating also can be certified by a Rating Judge or Regular Instructor, and it marks the beginning of specialized skiing in the three competitive events. For example, to obtain a Third Class slalom rating, the skier must show ability to turn at a bouy and be capable of riding one ski across both sides of the wake in one continuous motion and return, and accomplish this maneuver three times in succession without falling. Or



One of the fundamentals necessary for a novice rating is a start from a dock.

The sideslide on one ski is a trick most skiers ordinarily perform when accumulating points for a trick rating.

he may elect to try a slalom test on a regular course on one or two skis, and make four or more consecutive buoys at any constant speed.

In jumping, a Third Class skier must be able to jump onto and off the wake, with skis clearing the water, without falling. He also must be able to go over a jump ramp, set anywhere from four to six feet in height, and complete two out of four jumps, riding out 100 feet from the ramp in good balance.

In the category of trick riding, a Third Class skier must be able to perform a minimum of 120 points worth of tricks without repeating any of them. As sample point values, a sideslide on two trick skis counts 20 points; a two-ski, 180-degree turn (from front to back), 30 points.

Both Novice and Third Class ratings, including wallet cards and jacket emblems, can be awarded to skiers whether they are members of the AWSA or not. However, for any of the four higher ratings—Second Class, First Class, Expert or Master—association membership is required. A skier good enough to be rated Second Class in a competitive event would probably want to try his hand in a sanctioned tournament, anyway, and this requires membership in AWSA.

Divisions of competition include junior boys and junior girls; boys and girls; men; women; senior men; and senior women. Ages are calculated as of January 1 of any given year.

Thus, for example, to obtain a Second Class slalom rating a skier must be able to make a perfect pass through a regulation slalom course at a boat speed of 26 miles an hour for men and at 24 mph for boys.

The distance requirement in jumping for a Second Class rating varies similarly according to division, ranging from 25 feet

In jumping, the greater the distance covered by the jump, the higher the rating.

▲ *In slalom tournament ratings, the boat maintains a straight course at increasing speeds as the skier zigzags around buoys on either side of the course.*

for junior girls to 55 feet for men. Points required for the rating in tricks likewise run from 200 for juniors to 550 for men, to be scored in two 20-second passes, the time actually established for competition trick skiing. Second Class ratings can be certified by an Assistant Judge or a rated Senior Instructor.

In general, tests for First Class and Expert ratings in the association simply involve higher boat speeds in slalom, greater distances in jumping and higher points in tricks.

It takes an AWSA Regular Judge to certify a First Class or Expert rating, and in the case of the latter, a cosignature of a Senior Judge or the chairman of the appropriate AWSA region also is required.

The top rating in organized water skiing is Master. This, too, is an extension of the proficiency in the three competitive events, but unlike the other ratings it must be earned in sanctioned competition, certified by the Chief Judge of a tournament and cosigned by the chairman of the AWSA region in which the tournament takes place.

When you meet a skier who holds a Master rating in any of the three competitive events, you can be sure he is able to ski with the best. He is to be compared with the scratch golfer or a seeded tennis player.

Of course, as in the case with the top-level players in golf and tennis, there is a fairly wide range of skill among water skiers who have attained the minimum requirements in slalom, jumping or tricks for a Master rating.

Furthermore, rating requirements in organized water skiing are changed from time to time, usually toward the more difficult. This is understandable when you consider that competitive water skiing is still a relatively young sport, and those who are charged with its administration are constantly confronted with an increase in the level of skill on the part of the participants.

A skier capable of attaining only a Second Class rating today would have won most of the big tournaments 15 years ago with the same caliber of skiing.

Similarly, in slalom and tricks, skills have progressed to such an extent that runs are being made today that were undreamed of even 10 years ago.

Thus, as skills change for the better, so requirements for ratings have to be upgraded accordingly. A Master rating should be reserved for the very best, and as skiers as a whole get better, this top rating must be made more difficult to attain, in the opinion of officials in AWSA. Another consideration is the qualification requirements for the National Water Ski Championships. At one time, a Master or an Expert rating, together with certain performance placement in tournaments, earned a skier the privilege of skiing in the Nationals. As a result, contestants taxed tournament facilities and officials to the limit to run off all the divisions and events within the days allotted to the meet. Not only did the AWSA raise the qualifications for the Nationals to Master ratings only and higher tournament placement, but they also toughened the requirements for earning a Master rating.

These changes are not made without considerable thought and study by knowledgeable officials of the AWSA. The association has a national Skiers' Rating and Classification Committee, with members from every section of the country, which constantly studies performances of skiers in the various rating categories. When the members agree that certain changes are indicated, they recommend them to the AWSA Board of Directors, which must then vote favorably before the changes are officially adopted.

Furthermore, ratings must be maintained by the skiers. A Master rating is good for only one year. This means that a skier must record a sanctioned tournament performance that measures up to prevailing Master rating minimums, and have the performance so certified, within a year of first attaining the rating or he automatically is downgraded to Expert. An Expert rating is good for two years from the date of first performance, while all others are good for four years. (Exception: ratings achieved in a National or Regional tournament are good through the same tournament one, two, or four years later, as appropriate.)

Thousands of skiers in the United States hold ratings that are recorded officially by the AWSA. More than half are rated Expert or Master in one or more events. So, you see, you will be entering pretty exclusive company if you spend the little time and effort it would take to obtain a rating.

In any case, take off on your water skis the first chance you get and see just how well you do rate. You may be better than you think T.H.

See also: SAFETY, WATER; SWIMMING.

WHERE TO FIND IT

For further information about obtaining a rating card, write to the American Water Ski Association, P.O. Box 191, Winter Haven Fla. 33880. You can also inquire about membership in the Association and receive data on becoming a judge, if you wish.

Executing a wake turn on two skis. This water ski trick is for the enthusiast who has advanced beyond the simple surface turns.

Tricks You Can Do on Water Skis

Any experienced water skier can learn to do these basic trick maneuvers, with a few spills and some practice

WATER SKIERS WHO become bored with routine turns around the lake and crisscrossing the wake on a single ski are turning more and more to trick riding, performing "aquabatics" on skis—and the tricks are not as difficult as they appear.

On learning a few basics, the sideslides and turn arounds that draw "oh's" and "ah's" from the sidelines are a cinch for the skier of even average ability. Tricking actually is less demanding than some of the other forms of water skiing. It lends itself to practically any type of towing rig from 15 horsepower up, outboard or inboard. Only moderate speeds are required—eight to ten miles an hour for youngsters and seldom over 20, even for heavyweights.

Trick skis are shorter, wider and lighter than conventional skis, and they have no fin or keel, thus permitting the slides and turns that are characteristic of most tricks. A towline for tricking should be light and strong with a minimum of stretch. Quarter-inch braided polyethylene or polypropylene is recommended, since these synthetics have

ideal characteristics. Water tricks require a line of about 75 feet, but the length should be shortened to from 40 to 50 feet for some of the more advanced tricks that utilize the boat's wake.

An ideal practice session for tricking is one that involves three skiers, each taking turns as boat driver, observer and skier. Practice periods thus can be broken down into eight- to ten-minute intervals, allowing each skier to rest and to observe faults and plan solutions.

Faster learners among trick skiers follow a few basic rules:

1. They learn to master the basic tricks before attempting the more difficult ones.
2. Once they learn a trick, they attempt to practice it under as nearly the same conditions as possible—same towline length, boat speed and skis.
3. Before starting any trick, they "think out" the actions their body must take to do the trick. They think first, act later.
4. They put a particularly difficult (for them) trick on the shelf until they have had time to analyze their problem and think out a solution.
5. They remember that, like all water skiing, trick riding is fun, and falling is part of the fun. As one old timer has put it, "If you ain't fallin', you ain't learnin'."

Let's take a turn through the maneuver that is incorporated in practically all tricks —the 90-degree turn known as the sideslide.

Boat speed: from 12 to 18 miles an hour.

Starting from a semi-crouched position with weight evenly distributed on two skis and arms slightly bent, pull the handle in toward the body with both hands evenly and firmly. Avoid jerking the handle.

To turn left, begin the turn as the handle is brought in. Release the handle with the left hand, dipping the left shoulder slightly. As the body turns, go into a slightly deeper crouch. At this point the right ski moves around forward of the left ski until it is square with the direction of the forward motion. Skis should be spread slightly apart and pressure exerted on the edges of the skis away from the towboat to keep them from digging in. The right arm is still bent to compensate for any slack or jerk on the towline and the free left arm is used for balance.

To return to the front position, simply move the handle out toward the front tips of the skis, maintaining balanced body position against the pull of the boat. To turn right, reverse the procedure.

The front-to-back or 180-degree turn is nothing more than a continuation of the sideslide, and is the next maneuver that should be attempted in learning trick skiing. Let's try this one turning to the right instead of the left.

Bring the handle in toward the body firmly with both hands, release the handle with the right hand and lower the right arm and shoulder in the direction of the turn. Crouching deeper, the body continues to turn with the left hand bringing the handle in closer to the body. At the 90-degree point—the sideslide position— the right hand should be extended behind the back, ready to receive the handle.

The left ski continues to come around until it lines up with the right ski, in backward position. Bending slightly more forward over your skis, you can maintain a balanced position against greater ski drag as the skis begin to track in their reversed direction. Once both hands again are on the handle, pull it in close to the body, with arms slightly bent to absorb recoil of the towline.

In skiing backward, do not look down at your feet. Look up toward the horizon or shoreline for better perspective and balance.

Once the 180-degree turn is mastered,

▲ *Demonstrating a toehold sideslide.*

the complete 360-degree turnaround becomes relatively simple. The critical move takes place at the exact moment the skier is in backward position. This involves the exchange of the handle from hand to hand. At the moment the right hand is able to grasp the handle securely, the left hand is released. The exchange should be done smoothly, with the handle always in close to the body and equal tension maintained against the pull of the boat. The arms act as springs to compensate for any pulls or jerks.

Proper handle passing is the key to the 360. Keep the handle in close with one hand so the other can grasp it promptly and firmly at the right moment.

Remember at the beginning of the turn never to haul in hard on the towline. Some skiers try to do this in the belief they can go all the way 'round before the line becomes taut again, but slack in the line at any point can result in loss of balance and a sloppy turn, even if it is completed.

An added thrill to these turnarounds can be experienced by performing them off the towboat's wake. The line should be shortened with the average outboard rig to about 45-50 feet so the skier is in sufficient wake for tricking. In the case of exceptionally light boats, an even shorter line and ballast aft might be required to kick up the desired wake.

In two-ski, 180-degree wake turns, the principle is the same as that of the water turns except that a leap off the wake is com-

bined with the turning action. The wake turn must be completed while the skier is in the air, so it must be executed faster than the basic water turn.

In a deep-crouch position, with arms slightly bent, cut from the smooth water directly behind the boat toward the right wake (or left, if you prefer). On reaching the lip of the wake, pull in on the towline, releasing one hand as the handle comes in close, leap up and turn. This leaping turn is one coordinated action and is the key to the trick. Head, shoulder and arm lead the turn. As the leaping turn is made, the handle must be close to the body and low, held at one end for quick reception by the off hand. Bend well over the front of your spread skis for best stability on landing in the back skiing position.

In the reverse of this maneuver, the back-to-front wake turn, the major problem is in knowing when the wake is reached. You soon learn to feel the wake with your skis, and with practice, you make the leap and turn just as the backs of your skis reach the lip of the wake. Remember to keep in a crouched, ready-to-spring position when angling toward the wake.

Some years ago, when these basic tricks were first performed on water skis, some of the more imaginative skiers decided to add an extra, more spectacular touch. Why not step over the towline while making the 180-degree turn? It sounded simple, but after a few unsuccessful tries, they decided that some dry land practice was in order. Here is the way to begin:

Attach your towline to a post or tree and assume a skiing position, with a ski on the foot you intend to use in the stepovers, say the left foot. In the front-to-back turn, begin from a slightly exaggerated crouched position. As you pull in the handle, begin your turn and "hop up" slightly with your "skiing" leg, clearing the towline with the stepover ski and coming to rest with the handle held by the right hand between the legs and the free hand ready to grasp the handle outside the left leg.

In competitive water skiing, tricking is one of three major events (jumping and slalom being the other two), and these tricks have point values. The simple two-ski sideslide, for example, is worth 20 points; the 180-degree front-to-back, 30 points, and the basic 360, 40 points. The more difficult stepovers are worth 80 (front-to-back) and 70 points (for easier back-to-front). The skier who tallies the most points in two 20-second passes through the trick course is the winner.

Skiing forward on one trick ski, the body weight is distributed on both feet, with approximately 60 per cent of the weight on the back foot. However, this weight distribution must be reversed when skiing backward on the single ski. In fact, the forward foot should hold roughly 75 per cent of the weight to keep the back or leading tip of the ski from digging in. Body position changes, too. Whereas you can ski almost upright forward, it is essential while skiing backward that the upper portion of the body lean well over the trailing ski tip.

The secret to all one-ski turns is the correct transfer and distribution of body weight to the skiing legs.

In the one-ski sideslide, again you go into a deep crouch from which you can spring some of your weight off the ski in a relieving action just as the handle is pulled in and the body turned. The skiing arm, waist-high, is bent to compensate for any tug of the towline while the free arm helps in balancing. As in the two-ski sideslide, the leading edge of the ski is tilted slightly upward. This is particularly important on the single ski since, at the slow-speed, it tends to track rather deeply.

In the 36-degree one-ski turn, you must master two critical maneuvers:

1. The handle must be quickly transferred from one hand to the other as the back position is approached. This will re-

The one-ski sideslide is a basic maneuver in trick water skiing.

sult in an off-center pull to one side of the body, causing a rotation to the front position. Remember to bring the handle in close to the body for a smooth exchange from hand to hand and keep the arm with the handle slightly bent to absorb shock.

2. As you come through the back position, you must transfer partial weight from the front to the back foot. This must be done immediately after the handle has been exchanged. Premature weight transfer will result in a back fall or unwinding reverse 180-degree turn. If the transfer is not made, the ski will drag, preventing a smooth sliding action of the front of the ski.

These are the basic tricks. You can add to them from a list of more than 40, with variations, recognized in the official tournament rules of the American Water Ski Association. You can next master the one-ski wake turns, then the toehold sideslide and turns, even maneuvers off the jumping ramp.

Just for fun, let's total your points once you can run through the two-ski sideslide, 180's and 360, the stepovers, and the one-ski sideslide and turns, described here. According to the rule book values, you have a trick run at this stage of 550 points.

Tricks represent the ultimate in the fun and fascination of water skiing. They are the challenge ever before the more advanced skiers; the simpler tricks are a challenge to any adventuresome skiers who wish to attempt them. T.H.

See also: BOATING; SAFETY, BOAT; SAFETY, WATER.

How to Slalom on a Water Ski

Anyone who has learned the basics on two water skis can learn how to slalom on one ski

A WHOLE WORLD OF WATER skiing fun and challenge exists between those first faltering moments on a single ski and the breathtaking 50-mile-an-hour buoy turn of a slalom champion, and it awaits any skier who is willing to follow a few basic pointers —and then practice.

Let's take a look at what scores of fine competitive slalom skiers have all experienced in their progress from floundering, off-balance beginners on a single ski to the graceful, polished performers they are today.

In the first place, most of them didn't try the single ski until they were thoroughly at home on two skis, until they had mastered the basics of good take-offs, landings and maneuverings. Nor did they start right out trying to ride one of the slim-tapered, "hot" slalom skis. Instead, they took their first halting steps in single skiing on a standard, square-backed ski they had become used to in pairs.

The transition from two skis to one is made by practicing the skier's salute—lifting one ski off the water and pointing it skyward. The maneuver calls for the skier to shift most of his weight to one ski, then lean slightly backward, lift the other ski, and bend and pull the knee in toward the chest. Dry-land practice is advisable before trying the salute on water.

A few spills in the beginning are inevitable, as all the champions will tell you. Most upsets are caused by the ski ploughing in during the first phase of the lifting process. In taking the ski up from the water, the foot should be arched so the ski tip leaves the water first and returns to the water last in the recovery.

Experienced skiers will also advise a beginner to try the salute first with one foot, then with the other to determine which foot feels more comfortable. Nothing in the rules of skiing dictates which foot a skier on one ski should lead with. Right-footed and left-footed skiers are about equally divided among the slalom competitors.

The first attempts to drop a ski and ride on one should be in the smooth water directly behind the boat, where the pull on the line is straight forward. The skier should slide his heel slowly and smoothly from the binding of the ski to be left behind while shifting his weight to the skiing ski. As he slips his toes from the binder, he should let his off foot and ski drift back until the ski simply slips off and is left astern.

The off foot should not touch the water. The knee should be bent as the skier gradually brings the leg in behind him and places the foot on the ski directly behind his forward skiing foot.

All movements should be made gradually and smoothly to avoid upsetting balance. This is the secret of riding on one ski. The skier will soon discover that his weight is about evenly distributed between his two

Jumping the boat's wake is good practice for beginning slalom skiers.

feet on the ski and that the weight on the back foot is what keeps the tip of the ski riding well out of the water on a gliding plane. He also will find that steering is accomplished simply by dropping a shoulder and leaning the body in the direction he wishes to go.

The beginner should not try to cross the wake immediately. He should wait until he feels comfortable on the ski in slow, shallow turns within the wake.

The technique of crossing the wake on a single ski is essentially the same as that on two skis: cross quickly at a sharp angle, with knees bent to absorb the shock of the rough water.

Once a skier begins to feel at home on a single ski, the next item of business is to learn how to take off on one to avoid the trouble of dropping a ski and recovering it each time he takes a turn on the water. This means, of course, taking off from the beach or dock, or in deep water.

The latter is the most difficult, so if a skier learns a deep-water take-off first, the other techniques will be simple to master.

In learning a single-ski deep-water start, the skier once again is wise to use a standard square-back ski, rather than the tapered slalom, for better balance and control. He should sit back on the heel of his ski with the knee of his skiing leg bent into his chest. The next move is to stretch his free leg and foot as far out behind him and as far down in the water as possible, to serve as a sort of outrigger. This off leg is the secret to the stability needed to rise up and ski away in good balance. In fact, after the ski is on plane, the skier should be in no hurry to take his free foot from the water since it will continue to help him keep his balance.

A major point to remember in the deep-water start on one: keep your eye on the tip of your ski. The tip of the ski should be kept out of the water directly beneath the towline, and the skier should remain well back on his ski and let the towboat do the work.

A common problem for the skier is to fall off in the direction of his free leg. This can be avoided if the skier will twist his body slightly toward the free side so the towline tension pulls him toward his solid foot.

Only after the skier figures he has mastered the deep-water start should he try the beach and dock starts, and by then they should be easy.

▲ *Slaloming on the water requires muscle and coordination when leaning into a hard turn.*

▼ *Negotiating a turn.*

▲ *Crossing the wake for a novice rating can lead eventually to slalom competition.*

▼ *Getting started on one ski.*

In the beach or shallow-water start, the skier should wade out from shore to about knee-deep water. Then, standing on his free foot, he should bend his skiing knee so the ski tip is above the surface and the back of the ski a few inches under. As the towbar takes up the slack in the line, the skier should turn slightly so his skiing side is toward the boat. With the boat moving slowly forward, the skier should wait until the line is almost taut, then yell for the driver to "hit it."

The skier should not attempt to step off onto the ski until the snap of the towline forces him to take off. On attaining forward motion, he should lean back, keeping his arms straight and letting his free foot drag for stability. Again: eyes on the tip of the ski.

A dock start involves basically the same principles. As the line is almost taken up by the slowly moving boat, the skier, either from a sitting or standing position (sitting is easier in the beginning), turns slightly toward his free side and commands the driver to hit it. Once more: ski tip up, free leg dragging for balance, arms straight, eyes on ski tip.

The thrill of crossing the wake and swinging back and forth in wide figure S's may seem like the ultimate to beginning skiers, but actually it is only the beginning of the fun for those who are really interested in slalom. This phase of a skier's progress can be compared to that of a golfer who has gotten his kicks on a driving range but never tried on a real golf course.

Once a skier has graduated from two skis to one, he should become accustomed to the thoroughbred of the sport—the sleek, tapered slalom ski—before taking his turn on a regulation course. Plenty of practice making S-turns on an imaginary course on this hot ski will save disappointments later when the skier tries to negotiate buoys.

A regulation course consists of six contestant buoys, plus guide buoys for the towboat, staggered through an area 285 yards long. The distance from the center line of the boat path to the three buoys placed alternately on either side is 12½ yards. From the entrance gate to the perpendicular line of the first buoy, the distance is 30 yards, and the same between the line of the sixth buoy and the exit gate. Distances between the line of all other buoys is 45 yards.

Running a slalom course is actually a race against time. Thus, a skier can pit his skill either against that of another or against the course itself. Obviously, the greater the boat speed the more difficult the course is to negotiate. Although official competitive rules establish minimum and maximum speeds for the various divisions of competition, informal or novice contests can be staged at any agreed-upon starting speeds.

The idea is that a skier continues to run the course at gradually increasing speeds until he misses a buoy. The contestant with the most consecutive buoys negotiated is the winner.

In the case of sanctioned competition, starting speeds vary from 24 miles an hour for junior girls to 30 miles an hour for men. Maximum speed for junior girls is 30 and for men 36. When contestants have successfully negotiated the course through the maximum speeds with the full slalom line of 75 feet, the line then is shortened for additional runs through the course at the top-speed. First, 12 feet are taken off the line, then additional six-foot increments until the skier misses a buoy.

To a skier who has just learned to drop a ski and take his first, shaky turns across the wake, this caliber of slalom must seem an impossible distance over his skiing horizon. However, before discouragement takes over, he should take a look at the thousands of people of all ages who are experiencing the incomparable exhilaration of slalom skiing. T.H.

See also: SAFETY, WATER; SWIMMING.

How to Water Ski on Your Bare Feet

If you can water ski on skis, you can do it on your bare feet. The secret lies in having a powerful towboat

FOR THOSE WHO FEEL a little shaky riding water skis across the water for more than a brief turn around the lake, it must be difficult to imagine skiing for more than an hour on your bare feet!

It has been but a few years since barefoot skiing was so unusual—and astonishing to the casual spectator—that it received top billing in the big ski shows. It still is a featured act, but now its exponents ski backward on one foot, make beach and deep-water starts, and even accomplish turn-arounds in order to keep ahead of the growing number of nonprofessional barefooters on waterways all over the country.

The Barefoot Club, started several years ago by the American Water Ski Association to give special recognition to skiers who could barefoot continuously for more than 60 seconds, now has a large membership. Boys and girls as young as eight have filed certified performances.

Ski-less water skier is skimming over the surface of the water at about 35 miles an hour on his bare feet.

Trying it backward. Barefoot skier is wearing a jacket rather than a belt. Belts tend to come off during spills at the high speeds required for barefoot skiing.

One American barefoot endurance record was held by a college student, who had the added distinction of having carried a grown young woman piggy-back while barefooting.

Internationally, the Australians have taken to this phase of water skiing with even more enthusiasm than Americans. They have been holding national barefoot tournaments since 1963 and have added to their repertoire such maneuvers as the barefoot sideslide, one-foot barefoot with rope on toe, double barefoot jump out of two skis, barefoot ramp jumping, as well as the conventional beach and deep-water starts, backward barefooting and turnarounds.

If all this seems completely out of reach, even to the above-average water skier, don't despair. In the first place, with today's high-powered towboats barefooting is not nearly as difficult as it may seem.

That's the first requisite—power. You need a boat capable of pulling a skier from 35 to 40 miles an hour. Most experts agree that 35 mph is the best speed for barefooting, with 32 mph considered about the minimum. A good formula for determining how much speed is needed for a particular skier is to divide his weight by 12 and add 20. Thus, the heavier the skier, the more speed (and power) required.

Calm water is almost as essential as plenty of power for the beginning barefooter. Slight ripples are no problem, but waves of three inches or more are tough to overcome when you are just learning. The tow rope should be long enough to permit the skier to ride comfortably on either side of the boat wake in order to gain smooth water.

After donning a jacket-type safety device (a ski belt will usually come off in a high-

➢ *Water skiing backward on one foot.*

speed fall), take off on a single ski from which the binder has been removed and replaced with a small piece of nonskid tape.

As the boat speed gradually increases, remove the back foot from the ski and put it lightly on the surface of the water, heel down and toes up, to get the feel of the water pushing upward and backward against the sole of the foot. Carefully put more and more weight on the off foot until you are certain it is supporting at least half your weight.

Now is the time for the critical maneuver —removal of the other foot from the ski. Shift your weight far back until you feel you are almost sitting in the water, and at the same time push the ski away with a slight circular motion of your foot. This moves the ski aside; if you try to pick up your foot, the ski will come with it because of the water pressure.

The idea is to get rid of the ski as promptly as possible so both bare feet can take an equal share of the load and balance can be maintained. This is not easily learned, so don't be discouraged if you take a few tumbles.

Once you have succeeded in staying up on your bare feet, you can adjust your leg and body position for the most comfortable ride. There is no such thing as "the correct way" to barefoot. Some barefooters keep their legs straight; others bend them slightly to act as shock-absorbers. Some barefoot with their feet wide apart; others keep them close together. Some bend their arms slightly; others hold them straight.

Much depends on what the barefooter is attempting to accomplish at the moment. Some experts contend that a long run over relatively rough water requires the skier to keep his feet farther apart than he would

have to under less rugged conditions. In an endurance run, the barefooter will frequently change his leg and body attitudes to conserve his energy and avoid muscle cramp.

One skier reported that after barefooting for 45 minutes, his right foot became so numb that he couldn't control it, so he lifted it momentarily to wiggle his toes. This rest maneuver worked so well that he was able to move past the hour mark. But soon both feet became numb, and when he was confronted with the rough water of a boat wake he was forced to give up—after over 67 minutes of barefooting. In setting the new mark, the youngster had barefooted over 35 miles!

The first public demonstration of barefooting was given in March, 1947. Shoe skiing on small boards not much larger than a man's foot had been popular for some time among expert skiers, and barefooting was an inevitable development. It remained primarily a show act, however, until 1961 when the Barefoot Club was organized and the strictly ski-for-fun enthusiasts began to realize that the specialty was not as difficult as it appeared.

The real fun of barefooting obviously does not come with endurance efforts, but rather in the act itself and in learning the various maneuvers that can be mastered by the confident barefooter.

Take the beach barefoot start. Here is the step-by-step procedure most experts use: Pick a smooth, sandy or grassy beach that is free of stones and sharp objects and has a gentle slope toward the water. Use a powerful towboat, one with at least 150 horsepower, for quick acceleration. Start far enough up on shore—usually about 50 feet—so your sit-down speed when you hit the water will be about 20 miles an hour.

From your standing start, signal the boat to move out, and as it picks up speed, begin running to keep up. About five feet from the water's edge, throw both feet out in front and slide the remaining distance on the seat of your bathing trunks.

Once in the water, ride on the backs of your legs and buttocks, with your feet just above the water, until the boat speed is sufficient to raise your entire body to the surface (about 25 mph). At this point, ease the soles of your feet into the water and begin to place your weight on them. As the speed increases above 30 mph, you can rise up and assume a normal barefooting position.

The main precaution you must take is to lower both feet in the water at the same time to avoid unequal drag, which will force you into a sideways position. Another pointer is to keep the handle low to aid in maintaining the correct position in the water and to prevent your feet from digging into the beach before you reach the water.

The deepwater barefoot start is somewhat similar to the beach start but requires even more strength and stamina. The biggest problem is maintaining body position until the towboat attains a speed of about 20 mph when you can rise up to the seated barefoot position used in the beach start. To maintain starting stability, some use a layout position in which the feet are clamped tightly against the towline. Others bend more at the waist and keep the handle in solidly against their legs to help hold them straight. In either case, the idea is to use as much body area as possible at the start to get to the surface of the water the quickest way. If you do not rise to the surface rapidly, the handle will be pulled from even the strongest hands.

The Australians and a few skiers in this country have mastered what they call the tumble-turn start. They begin by being towed on their stomachs behind the towboat. As the boat speed increases, they flip onto their backs, bounce a second time to maneuver their feet forward and rise up onto their feet out of the spray. T.H.

See also: SAFETY, WATER; SWIMMING.

Fair weather lies ahead, as long as these cumulus puffballs float in a clear, blue sky. Ordinarily they thicken somewhat in early afternoon and thin out near sunset. Sometimes, one will rise in the middle and turn into a brief summer shower rain cloud.

Be Your Own Weatherman

Nobody can beat the experts in making a general weather forecast for a large area over a period of time, but if you want to know what the weather will do this afternoon at a particular location, you can do a more accurate job yourself

THE SMALLER YOUR BOAT, the more important it is for you to watch the waves and weather. If an ocean liner constantly plots weather maps and monitors shoreline reports, it should be at least as vital for the pleasure boat skipper to keep track of any squalls that could come.

Small bodies of water can fool you. The steep chop of a little pond can swamp a skiff more quickly than the long swells of the open ocean. In the old days, sailing ships would head out to sea when a storm threatened and even today merchant vessels will delay docking until rough shoreline seas have subsided after a blow.

But boats built for inland waters are often smaller than coastal craft, and they have lower sides that let a wave slop aboard and swamp a hull more easily. There is nothing dangerous about the average small boat—many have ridden out hurricanes at anchor and drifted across oceans with no one aboard. It is only when boatmen take

weather signs: see camping

them out and push them into unfavorable weather that things may go wrong.

Let's assume that if you know a storm or high winds are on the way, you know enough to stay ashore. After all, in a pleasure boat you don't have to go out. But how can you be sure the weather will be fine? How can you be forewarned if you're already underway?

It's simple. There are a lot of complicated instruments available to help you, but there's no excuse not to have along the easiest of all to use—a pocket transistor radio. You can get regular reports from the experts from it. There are also a lot of simple shortcuts for finding out if bad weather is on the way well in advance. No need to be a meteorologist to know when you should play it safe and stay ashore.

When you're out boating, note from which directions your prevailing winds and squall lines normally approach. Then use your radio to tune in towns over in that direction. Even when no regular weather reports are scheduled, a sudden thunderstorm or squall line approaching—one that could give you trouble on the water—will be mentioned. A slip of paper, slid inside the transistor's case, can carry your list of stations, frequencies, and times when the weather is broadcast. Look in a local paper if you're boating a new and different area.

When cumulus thickens and forms towering anvil shape, it means a squall with high gusts and heavy rain. A thunderhead like this one hanging over distant mountains won't mean much, but when they start forming nearby it's time to take them seriously.

Listen for reports of strength and direction of wind, visibility, precipitation, rising or falling temperature and barometer. In general, a rapid change of any of them can indicate a weather change that needs close watching. Perhaps a frontal system is approaching or has just passed the station and is headed your way. Usually the broadcast will give some forecast interpretation if a weather change is likely. Again, as a generality, a rapidly falling barometer and thermometer may show the passage of a cold front with dangerously brisk breezes.

The key to barometer reading is not what it reads but a watch on where it's been. A change in barometric pressure usually means a change in the weather. A rapidly falling barometer points to a change for the worse for the boatman. Pleasant cool weather may be on the way, but first may come strong winds. We're not recommending you carry a pocket barometer (although craft with dashboard or cabin instruments can easily add one). But if you go boating without a small portable radio—and if you don't use it to check weather reports—you're not old fashioned, you are needlessly careless and foolish.

If you can spend more for your portable, you can turn it into an almost constant weather watcher. Transistor models can be found that tune in short wave 2,000 to 4,000 kilocycles of the so-called "marine band." Here boating weather is broadcast morning and evening in many parts of the country, and special warnings are also aired if storm conditions threaten. For another jump in price there are portables that pick up long wave as well as shortwave and the broadcast band. This is a 200 to 400 kilocycle spectrum, below the broadcast band, and it is here that the smart boatman takes

➤ *A cumulonimbus looming up in your back yard means high winds, heavy rain, dangerous sea conditions and, in warm weather, thunder and lightning.*

advantage of the excellent weather broadcasts transmitted for aircraft. Every half hour, extensive weather condition reports are given for the airfield and nearby towns, as well. These are not forecasts; they only describe what it was like at each reporting point an hour before. But because of the number of reports, a boatman can hear a trend if thunderstorms should be moving his way. Within radio range of big metropolitan centers, your luck is better still. There you are likely to find an airport control tower that broadcasts continual weather reports 24 hours a day non-stop. All on long wave.

Radio direction finders tune in the long wave band since radio beacons, lighthouses and other navigational aids that broadcast are usually on this frequency. Small compact self-powered direction finders are now available, and they perform well as both navigation and weather aids. With just a simple portable that receives long wave, broadcast, and marine bands you're in luck, however. Rotating any set can give a rough directional steer with the internal antenna, but on that long wave band you can also pick up aircraft beams. Buy an aeronautic chart, listen for the beam's call sign, and you can pilot along through a fog or at night. Find where two intersect and you've got a fix that pinpoints you on your chart just from listening—all without any skill in swinging a directional loop, listening for the null and the rest.

Once you start monitoring long wave and marine band comments and reports, you

Cirrostratus clouds of high-altitude ice crystals often cause a halo to appear around sun or moon. With the wind steady between northeast and south they can indicate rain or snow a day away.

might be tempted to leave the set on loud and bore your crew as well as annoy craft anchored nearby. Larger portables and direction finders do not always have a jack for an earphone, but it's a particularly easy and inexpensive accessory for you to add.

And one more word about this indispensable weather aid: Don't take an FM radio along unless it receives AM as well. FM can filter out objectionable static—that's considered one of its advantages. But afloat static isn't unwanted in this case. Those crackles mixed with the music and ball game on a hot summer afternoon tell you, "Look at the clouds!" and "Watch the horizon!" Your little AM receiver is popping out an early warning that thunderstorms are in the area and may be headed your way. A towering anvil-shaped cloud and a dark horizon mean you may need to head for harbor under power or lower and lash down all the canvas of a sailboat, close all ports and hatches, and prepare for sudden severe winds under the dark bottom of the cloud. A thunderstorm can create instant waves and swamp an unprepared boat.

Cloud watching is an advanced aid to weather forecasting, and in addition to the anvil mountain of the thunderhead, there are low and high recurring cloud formations that tell of typical conditions to come. They vary somewhat, according to your section of the country, but in general they are accurate omens of weather that may follow.

But suppose you are used to the rainy climate of Puget Sound and then trail south

Stratus clouds like these indicate rain is on the way, as well as very restricted visibility if the winds are steady between northeast and south. It's time to head for shore.

Cumulus fractus clouds are an indication of rain and worsening weather, although they also could bring scattered clouds with winds.

to San Diego, or launch on the Chesapeake for a vacation from the Great Lakes. Weather patterns may be very different. How do you find out?

Fortunately the local marine stores can help you once you arrive. They will brief you with general information, and are likely to stock cruising guides which outline weather problems unique to the region. Boatmen can learn a great deal by ordering the Coast Pilot.

Boatmen heading for seashore waters can learn a great deal by ordering the Coast Pilot books prepared by the Coast & Geodetic Survey in cooperation with the Coast Guard, Weather Bureau, and Corps of Engineers, and available from the U.S.C.&G.S. chart outlets. Exceptionally useful, they give such information as: "The Santa Ana is an offshore desert wind usually occurring in or near San Pedro Bay. While infrequent, it may be violent. These winds are most apt to occur in late autumn or winter and at times may reach a speed of 52 knots.

"Meteorological conditions are favorable for a desert wind whenever a strong area of high barometric pressure moves in or develops over the Plateau region, and the barometric gradient calls for northeast or east winds over southern California. . . . .

"These winds diminish little, if any, immediately after reaching the ocean at Newport, and some reports credit them with blowing considerable distances at sea. How-

ever, beyond 50 miles from shore they are usually of no particular concern.

"Aside from weather forecasts by radio, the mariner has only short notice of the approach of a Santa Ana. . . . Shortly before its arrival on the coast, the Santa Ana may be observed as an approaching dark-brown dust cloud. This will often give 10 to 30 minutes warning. . . ."

—Pacific Coast Edition,
U.S. Coast Pilot 7

This, and much more, is the kind of weather information these excellent and inexpensive books give, in addition to detailed data for harbors and the coast lines. For inland waters, gasoline company booklets and other guides offer less detailed but similar information.

Storms and fogs are the most serious threats to the boatman and, again, the various guides will warn when they are likely to occur, their duration and severity, plus precautions and suitable ports of refuge. Fog is almost sure when the boatman's radio tells him temperature and dewpoint are approaching the same reading. Then he must be particularly sure of his position as the white cotton curtain drops in. Local knowledge can indicate if fog usually burns off and blows away later in the day, and if it is safe to plan for a noon departure. Or conditions may make it plain that the wise course is to stay tied up and wait.

Storms can occur anywhere, but the inland boatman is lucky since the strength of that really damaging storm—the hurricane—usually loses strength as it heads far in away from the water. Wind velocities of tornadoes and twisters can be just as high, however, and much less predictable. A pleasure boatman will frequently keep his boat ashore if possible during such a threat.

The professional is seldom wrong about the big weather picture. The experienced amateur is seldom wrong about the little weather picture. But it's important to follow these basic rules:

1. Focus on the little picture—on the regional conditions that never show up on a weather map. Add your observations to the general forecast for the overall area indicated by weather maps, the Weather Service, or your radio.

2. To translate some of the signs you see on land into a prediction of what you'll find at sea, use the accompanying Beaufort Scale.

3. Always stay alert to the signs when you're out on the water. Even fast-breaking weather can seldom beat a fast boat back to shore.

4. Don't go out if you see the small craft warning (red pennant) displayed.

5. When you're making predictions, don't work more than 12 to 15 hours in advance. The small signs of a shift in weather seldom show up before then.

The weather's tendency to repeat itself is strong in yearly patterns and in patterns of change. The faster the weather has been changing in the recent past, the more likely it is that a new condition will develop fast and pass quickly. And if there has been a long spell of good weather, chances are that when it breaks there will be an equally long spell of bad weather. The recent pattern is the first factor to consider in any prognostication.

Nature's indicators. Naturally, when the weather does change, it will send signs in advance, and the alert amateur is always responsive to them. The weather's three ways of announcing a break are a change in air pressure, a change in wind direction, and a change in cloud formation. The professional weatherman's paraphernalia is built around instruments designed to observe and record these changes, but for a small specific area, your own un-instrumented observation is likely to be more reliable.

Consider air pressure, for example. The device for measuring changes in it is, of course, the barometer.

As important as the barometer is, though,

BEAUFORT SCALE OF WIND

BEAUFORT NUMBER	DESCRIPTIVE TERM	VELOCITY EQUIVALENT AT A STANDARD HEIGHT OF 10 METERS ABOVE OPEN FLAT GROUND				SPECIFICATIONS			Probable wave height in meters	Probable wave height in feet
		mean velocity in knots	m.p.h.	meters/sec	km/h	Land	Sea	Coast		
0	Calm	<1	<1	0–0.2	<1	Calm; smoke rises vertically	Sea like a mirror	Calm	—	—
1	Light air	1–3	1–3	0.3–1.5	1–5	Direction of wind shown by smoke drift but not by wind vanes	Ripples with the appearance of scales are formed, but without foam crests	Fishing smack just has steerage way	0.1 (0.1)	1/4 (1/4)
2	Light breeze	4–6	4–7	1.6–3.3	6–11	Wind felt on face; leaves rustle; ordinary vanes moved by wind	Small wavelets, still short but more pronounced; crests have a glassy appearance and do not break	Wind fills the sails of smacks which then travel at about 1–2 miles per hour	0.2 (0.3)	1/2 (1)
3	Gentle breeze	7–10	8–12	3.4–5.4	12–19	Leaves and small twigs in constant motion; wind extends light flag	Large wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white caps	Smacks begin to careen and travel about 3–4 miles per hour	0.6 (1)	2 (3)
4	Moderate breeze	11–16	13–18	5.5–7.9	20–28	Raises dust and loose paper; small branches are moved	Small waves, becoming longer; fairly frequent white caps	Good working breeze, smacks carry all canvas with good list	1 (1.5)	3 1/2 (5)
5	Fresh breeze	17–21	19–24	8.0–10.7	29–38	Small trees in leaf begin to sway; crested wavelets form on inland waters	Moderate waves, taking a more pronounced long form; many white caps are formed (chance of some spray)	Smacks shorten sail	2 (2.5)	6 (8 1/2)
6	Strong breeze	22–27	25–31	10.8–13.8	39–49	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty	Large waves begin to form; white foam crests are more extensive everywhere (probably some spray)	Smacks have double reef in mainsail; care required when fishing	3 (4)	9 1/2 (13)
7	Near gale	28–33	32–38	13.9–17.1	50–61	Whole trees in motion; inconvenience felt when walking against wind	Sea leaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind	Smacks remain in harbor and those at sea lie-to	4 (5.5)	13 1/2 (19)

8	Gale	34–40	39–46	17.2–20.7	62–74	Breaks twigs off trees; generally impedes progress	Moderately high waves of greater length; edges of crests begin to break into the spindrift; the foam is blown in well-marked streaks along the direction of the wind	All smacks make for harbor, if near	5.5 (7.5)	18 (25)
9	Strong gale	41–47	47–54	20.8–24.4	75–88	Slight structural damage occurs (shingles removed)	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble and roll over; spray may affect visibility	—	7 (10)	23 (32)
10	Storm	48–55	55–63	24.5–28.4	89–102	Seldom experienced inland; trees uprooted; considerable structural damage occurs	Very high waves with long overhanging crests; the resulting foam, in great patches, is blown in dense white streaks along the direction of the wind; on the whole, the surface of the sea takes a white appearance; the tumbling of the sea becomes heavy and shock-like; visibility affected	—	9 (12.5)	29 (41)
11	Violent storm	56–63	64–72	28.5–32.6	103–117	Very rarely experienced; accompanied by widespread damage	Exceptionally high waves (small and medium-sized ships might be for a time lost to view behind the waves); the sea is completely covered with long white patches of foam lying along the direction of the wind; everywhere the edges of the wave crests are blown into froth; visibility affected	—	11.5 (16)	37 (52)
12	Hurricane	64–71	73–82	32.7–36.9	118–133	—	The air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected	—	14 (—)	45 (—)
13	—	72–80	83–92	37.0–41.4	134–149	—	—	—	—	—
14	—	81–89	93–103	41.5–46.1	150–166	—	—	—	—	—
15	—	90–99	104–114	46.2–50.9	167–183	—	—	—	—	—
16	—	100–108	115–125	51.0–56.0	184–201	—	—	—	—	—
17	—	109–118	126–136	56.1–61.2	202–220	—	—	—	—	—

it has a couple of big drawbacks for the non-pro prognosticator. It has to be adjusted for changes in altitude: every time you trailer a boat from home to sea level or to a mountain lake, it has to be re-set—correctly. And for its readings to have real meaning, you should make them at regular, frequent intervals and chart them, because the rate of the rise and fall is as significant as the figure itself.

It is important for any would-be weatherman to pay careful attention to change in air pressure, because a drop in pressure is a frequent forerunner of storms. But there are other ways to note it than by reading a barometer. You can, for example, observe such self-setting instruments as birds, which tend to fly high in high pressure, low in low pressure. If you see them huddling under bridges and eaves, with their feathers fluffed and their heads drooping, don't go boating; there's a storm coming. Or watch the direction of smoke. If it rises straight up, it points to high pressure. If it curls to the ground, it's reacting to low pressure.

Trees are among nature's best weather instruments. First, because leaves, particularly the light, feather-shaped leaves of many of the trees found on lake shores, often respond to low pressure by turning their topsides down. Sometimes, way out on a big lake, you can look toward shore miles away, and catch a glint of the silvery undersides of willow trees. In language as plain as the red warning flag, they say, "Come in—the pressure's dropping."

Just as important, the direction of growth of trees tells you the direction of the prevailing winds anywhere you are. To the "intuitive" weatherman, this is at least as sig-

WIND/BAROMETER INDICATIONS

As a rule, winds from the east quadrants and falling barometer indicate foul weather; and winds shifting to the west quadrants indicate clearing and fair weather. The rapidity of the storm's approach and its intensity are indicated by the rate and amount in the fall of the barometer.

The indications afforded by the wind and the barometer are one of the best guides now available for determining future weather conditions. As low barometer readings usually attend stormy weather, and high barometer readings are generally associated with clearing or fair weather, it follows that falling barometer indicates precipitation and wind, and rising barometer, fair weather or the approach of fair weather. As atmospheric waves or crests (areas of high pressure) and troughs or depressions (areas of low pressure) are, by natural laws, caused to assume circular or oval forms, the wind directions with reference to areas of low pressure are spirally and contraclockwise inward toward the region of lowest atmospheric pressure, as indicated by readings of the barometer. Areas of low barometric pressure are, in fact, whirlwinds of greater or less magnitude and intensity, depending upon the steepness of the barometric gradient. Areas of high barometric pressure show winds flowing spirally clockwise outward.

The wind directions thus produced give rise to, and are responsible for, all local weather signs. The south winds bring warmth, the north winds cold, the east winds, in the middle latitudes, indicate the approach from the westward of an area of low pressure, or storm area, and the west winds show that the storm area has passed to the eastward. The indications of the barometer generally precede the shifts of the wind. This much is shown by local observations.

During the colder months, when the land temperatures are below the water temperatures of the ocean, precipitation will begin along the seaboards when the wind shifts and blows steadily from the water over the land without regard to the height of the barometer. In such cases the moisture in the warm ocean winds is condensed by the cold of the continental area. During the summer months, on the contrary, the on-shore winds are not necessarily rain winds, for the reason that they are cooler than the land surfaces and their capacity for moisture is increased by the warmth that is communicated to them by the land surface. In such cases thunderstorms commonly occur when the ocean winds are intercepted by mountain ranges or peaks. If, however, the easterly winds of summer increase in force, with falling barometer, the approach of an area of low barometric pressure from the west is indicated and rain will follow within a day or two.

From the Mississippi and Missouri Valleys to the Atlantic Coast, and on the Pacific Coast, rain generally begins on a falling barometer, while in the Rocky Mountain and Plateau districts, and on the eastern Rocky Mountain slope, precipitation seldom begins until the barometer begins to rise, after a fall. This is true as regards the eastern half of the country, however, only during the colder months, and in the presence of general storms that may occur other seasons. In the warmer months summer showers and thunderstorms usually come about the time the barometer turns from falling to rising. The fact that during practically the entire year precipitation on the great western plains and in the mountain regions that lie between the plains and the Pacific Coast districts does not begin until the center of the low-barometer area has passed to the eastward or southward and the wind has shifted to the north quadrants, with rising barometer, is an important one to note.

WIND/BAROMETER CHART

Wind Direction	Barometer Reduced to Sea Level	Character of Weather Indicated
SW to NW	30.10 to 30.20 and steady	Fair, with slight temperature changes for 1 to 2 days.
SW to NW	30.10 to 30.20 and rising rapidly	Fair, followed within 2 days by rain.
SW to NW	30.20 and above and stationary	Continued fair, with no decided temperature change.
SW to NW	30.20 and above and falling slowly	Slowly rising temperature and fair for 2 days.
S to SE	30.10 to 30.20 and falling slowly	Rain within 24 hours.
S to SE	30.10 to 30.20 and falling rapidly	Wind increasing in force, with rain within 12 to 24 hours.
SE to NE	30.10 to 30.20 and falling slowly	Rain in 12 to 18 hours.
SE to NE	30.10 to 30.20 and falling rapidly	Increasing wind, and rain within 12 hours.
E to NE	30.10 and above and falling slowly	In summer, with light winds, rain may not fall for several days. In winter, rain within 24 hours.
E to NE	30.10 and above and falling rapidly	In summer, rain probably within 12 to 24 hours. In winter, rain or snow, with increasing winds, will often set in when the barometer begins to fall and the wind sets in from NE.
SE to NE	30.00 or below and falling slowly	Rain will continue 1 to 2 days.
SE to NE	30.00 or below and falling rapidly	Rain, with high wind, followed within 36 hours by clearing, and in winter by colder.
S to SW	30.00 or below and rising slowly	Clearing within a few hours, and fair for several days.
S to E	29.80 or below and falling rapidly	Severe storm imminent, followed within 24 hours by clearing, and in winter by colder.
E to N	29.80 or below and falling rapidly	Severe northeast gale and heavy precipitation. In winter, heavy snow, followed by a cold wave.
Going to W	29.80 or below and rising rapidly	Clearing and colder.

nificant as an aching joint, because as long as the wind is blowing in its usual direction, bad weather is unlikely. The reason is that weather moves with the winds; without a change in wind direction, there's no change in the weather. And naturally, since the ordinary weather in most of the populated areas of the world is "good," this means that the prevailing winds are part of the ordinary "good weather" package. But the opposite is also true. When winds are blowing in a different direction than the usual one—different than the line of growth of plants and trees—then start looking for the other signs that may mean trouble.

Clouds are prophets. Look, for example, at the sky. If there are fleecy cottonball clouds, you can expect pleasant weather with moderate breezes. But if the clouds are low, dark, and fast-moving, or if they're high, fast, and moving in a direction opposite to that of the surface wind, batten the hatches and start for home.

Fast-moving clouds mean strong winds; dark ones mean rain; and any time that clouds are headed in a different direction than the surface wind, you can be sure that there's enough instability to make a sudden and violent change of weather very likely. White streaky clouds near the horizon often mean the same thing.

Manufactured instruments. With a weather eye out for clouds, winds, and pressure changes, you can generally match the Weather Service's best, with no investment in any kind of hard goods. But if it makes you feel nervous not to have gauges to peer at, by all means use the boater's

basic weather instruments: the compass and the barometer. Using these together, you can get most of the facts you need about wind direction and air pressure in reassuring calibrated form.

But first you have to set the barometer. Air pressure depends on the weight of the air mass above any given area, and so does the barometer reading. At sea level, an average fair-weather reading is 30.10 to 30.20. But for each 900 feet of altitude the air pressure and the barometer reading drop about 1/30th of their sea-level value. The booklet of instructions that comes with a new barometer usually tells you how to make the compensation for various altitudes. If it doesn't, check with the Weather Service for any area you're not sure about.

Whether you use a barometer or the birds, pressure observations are much more telling when you relate them to wind observations. For this reason the U.S. Weather Service has put together the accompanying Wind/Barometer Chart. Read it and keep a copy aboard your boat with your weather instruments.

You'll note that the barometer observations all imply continuing observation; its not enough to peer at the barometer once or twice—you've got to keep track of the rate of rise and fall. For the earnest but lazy amateur meteorologist, a happy alternative to keeping 24-hour watch on the glass is the recording barograph barometer, which obligingly traces its own chart of the peaks and valleys of pressure. It runs on electric current, which makes it impractical for most boats, but it's unusually helpful and reliable.

If you're really dedicated to the instrumental approach to forecasting, another good addition to the barometer-compass duet is the hygrometer. This device measures relative humidity, and when you add this figure to some local experience, it can be very useful indeed.

Obviously, you're not going to get caught in the rain if the humidity is 25%, but in some areas crackling-dry weather is usually followed by high winds. Elsewhere high humidity and high temperatures often point to violent thunderstorms, which you would want to avoid. A hygrometer can keep you out of a lot of trouble if you learn to interpret it well.

See also: CAMPING; NAVIGATION; WIND GAUGE.

One form of mackerel sky, these altocumulus clouds are fanning out in front of an advancing frontal system. Bad weather could be 24 hours away.

Keep Your House Warm with Weather-stripping

No matter how carefully you've caulked your house, wintry winds will still discover a chink you missed, or one that cannot be caulked. Here's how to seal those remaining chilly drafts

HOWEVER DILIGENTLY you've caulked all windows and doors, it's not until the wintry winds huff and puff that you discover an uncomfortable draft here and there. This certainly is not a time to drag out the ladder and fumble with caulking guns—in fact, caulking compounds just won't flow or adhere in freezing weather. Piling a rolled-up rug or similar draft-stopper along a door bottom is a common enough practice, but has its obvious shortcomings. Much more logical and effective measures may be taken with convenient, ready-made weather sealers.

An automatic door bottom, one that rises out of the way to provide clearance for opening the door, can be installed in just a few minutes, without exposing you to the weather. It has a sliding wood strip, edged with foam plastic; the action of closing the door pushes this strip downward so the foam presses tightly on the door sill. When the door is opened, the strip rises by spring tension to clear the floor.

To install, measure the wood bottom to fit the door opening, but do this with the movable strip pushed in flush with the edge. Place the unit in position with the door closed and the foam pressed down tightly, the movable section on the hinge side of the door. Drive an awl or nail through the predrilled holes to mark the screw positions, then open the door and attach.

A small metal strike plate is nailed to the side where it will contact the sliding strip. When the door closes, the metal striker will push the sliding strip downward so it presses tightly against the sill, sealing out cold air movement.

The sides and top of entrance doors are likely to be less than perfectly sealed especially in exposures subject to high winds. A dependable cure is to nail foam-edged wood strips around the frame, onto the outside door stop moldings. Wood strips are mitered at the top corners and nailed on when the door is closed with a slight pressure of the foam edging against the door surface. The extra edging may require a bit more pressure when closing the door because of the tighter seal.

In instances where the door is not closely fitted, leaving gaps between the door and jamb, an application of felt stripping along the inside edges of the door may be necessary. This is not attractive, certainly, and should be regarded as a temporary measure pending correction of the basic condition, when fair weather permits, with permanent

weep hole drilling: see masonry
wheel bearings: see bearings
whitefish: see fishing
wicks: see candle making
wilderness craftsmanship: see craftsmanship

➤ *Wintry drafts are sealed out quickly by attaching automatic door bottom with foam-edged strip that moves down to press tightly against sill when door is closed. When door is opened, spring lifts the strip to clear the floor.*

interlock weather-stripping or by resetting the door stop moldings.

Install the felt strip with the door closed, so that the proper pressure may be determined. Start at the lower end of one side, holding the felt in position under the desired pressure with a nail or two, then extend the felt to the top and make a miter cut, holding the top with another nail. Draw a line along the outside of the metal strip; open the door and shift the strip positions slightly into the door opening after removing the brads, to increase the pressure. Renail the felt in place on all three sides of the doorway. Miter the corners to avoid any air gaps.

Rattling and drafty double-hung windows may also be corrected from the inside with foam-edged wood strips. With the window open, press strips lightly against the far-side sash. Attach with thin brads. Then place strips in the same way on the inside surface pressed against both parts of the window. At the top and bottom, fit strips exactly flush between the vertical ones. Thus when the window is closed, top and bottom edges will press on the foam plastic that will extend a bit beyond the position of the wood strip itself. The foam will take up any slack that causes window rattle, and also help make the windows more air-tight.

Another method of sealing windows is with springy bronze strips which provide a friction closure, but are not visible when the window is closed. Buy the 1½-inch width in economical 50- or 100-foot coils.

Cut the strips to just slightly less than the length of the window channels, so the springy part does not become snagged. Slip the strips alongside each sash, the edge of the bronze having the nail holes toward the inside of the house, and the strip moved forward to almost touch the farthest divider strip of the frame for each sash. The easiest way is to raise the sash to the top, slip the strip inside, flatten the strip into the channel, then lower the window carefully. Now lower the sash again to start nailing from the top, flattening the bronze as you go to make sure that it has clearance. Lift the sash

Two-part draft sealer is cut to fit between the door stops. Keep the movable strip flush with edges of main housing when sawing.

Locate the unit in position while door is closed, marking position of screws by driving awl point into pre-drilled holes. Then open door to attach. Sliding bar extends at hinge side of door.

Another type of bottom draft sealer is vinyl stripping in aluminum retainer that is attached along the bottom of the door. Oval-shaped holes allow easy adjustment of strip.

Sides and top of door are draft-sealed with strips of foam or felt, tacked along the edges of the door frame. Press the stripping slightly to obtain adequate pressure when door is closed. Some types are self-adhering.

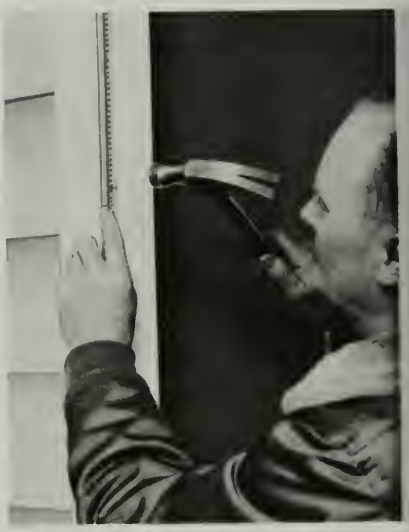
Rope-type caulking compound permits quick and neat sealing of gaps in window and door frames. One type of sealer is applied from handy coils, pressed into place with the fingers.

Tubular vinyl weather-stripping with serrated metal binding is used to close gaps in doors, windows and various other drafty openings.

and continue for the rest. While the sash may remain in place and thus needs the weather-stripping for only half the length of the channel, a shorter piece of bronze would possibly become snagged when the sash would be opened and closed, so it is better and neater to cover the whole length.

The top edge of the upper sash, and the bottom edge of the lower sash, similarly receive strips of the spring bronze. Thus, when the window is closed, the compression against the metal seals off the air currents. If there is a marked movement of air at the meeting rails of the two sashes, this may be overcome by nailing a strip onto the inside edge of the lower rail of the upper sash, the springy edge facing down. This permits raising and lowering the inner sash, and assuring a tight meeting joint when both are closed.

See also: CAULKING; DOORS; STAPLE GUN; STORM DOORS AND WINDOWS; WINDOWS.



How to Identify Wild Flowers

You can begin a fascinating and inexpensive hobby as a wild flower enthusiast, or even as a collector. But be careful about picking wild flowers, some species are in danger of extinction

WILD FLOWERS ARE FOR campers. They're for hunters, fishermen, backpackers, mountaineers, day hikers, forest rangers, photographers, your family and mine. Why? Herbaceous plants, those that die down at the end of the growing season, are as vital in life's chain of interdependency as insects, birds, trees, soil, water and man.

Few outdoor pursuits can be enjoyed so fully, with less initial expense. You can buy an inexpensive field guide at almost any book counter.

Wild flowers can be enjoyed without our picking them into extinction. Snatching up large multiflowered bouquets is exploitation, not cultivated appreciation. Dedicated wild flower hunters are usually satisfied with a sighting, a close examination, a notebook entry, and maybe a photo.

Collecting and pressing wild flowers is okay if you know you aren't erasing a rare species, one that doesn't reseed or transplant readily—like the trailing arbutus, the fringed gentian, the lady's-slipper or any of hundreds more.

When collecting and pressing flowers, be selective. Practice first on weeds and abundant flowers. Choose one, not 10, of a species from a patch. Old newspapers serve as handy folders for drying. Just fold the newspaper once; include a note with the date and location of the find. Insert a pad of 5 to 10 newspaper thicknesses between each folder; and place a heavy, evenly distributed weight on the top of the stack. Change the pads twice a day for several days, substituting dry pads, letting the wet ones dry for future use. If you use this method, your flowers will usually be dry in about a week.

Dried plants can be mounted with white glue or adhesive tape in a loose leaf scrapbook. And you can get as technical as you like when you label them. Often, paging through your scrapbook, you'll find single specimens bringing whole camping trips to mind with the scenes and events leading to your locating a rare species. Avoid picking along roadsides if it's possible to lift the same specimen from a secluded clearing. Many parks and recreation areas prohibit

wild foods: see outdoor life

Some campers travel widely, but never deeply. Some plunge into dense forests and scale rugged terrain without really seeing natural flora.

Dogtooth violet, also called snow lily, is white, blue or lavender-tinged; popularly termed a mountain plant, it needs several years for flower production and is usually encountered as mere patches of leaves.

picking—mainly directed at bouquet hunters but also at unrestrained wild flower hunters.

You'll find too that the sharp-eyed focus required for spotting wild flowers will improve your awareness of other wildlife. You'll catch so many more flashes of squirrel and chipmunk tails that you'll wonder if they too subscribed recently to the population explosion. Camouflaged reptiles, birds and insects will no longer elude your eye. Best of all, you and your family will really begin to feel the importance of protecting and enhancing the quality of life in our environment.

Wild flower experts at your botanical garden are usually willing to help you with information. If you have any questions or desire assistance in identifying wild flowers, ask them.

Pink lady's-slipper is northern member of orchid family, does not transplant or reseed easily; do not pick.

Crown vetch has cloverlike bicolored flowers of pink, white; vetches are creepers; bloom late spring, summer.

Skunk cabbage has large, globular leaf of spotty green, brown, blue; in spring, it generates enough heat to thaw soil and ice as it emerges; smells skunklike.

Indian pipe grows to one foot in shady forests; lacking green chlorophyll, it is translucent; and like the mushroom, it obtains food from live or dead organic matter.

Cactus family's prickly pear sports 2- to 3-inch yellow flowers. Sometimes mistaken for leaf, the oval padlike stem offers edible pulpy-red fruit. Caution: stem's bristle tufts contain barbed hairs which penetrate skin, cause inflammation, pain—one of few cacti in East.

Dogwood family's bunchberry is cold-woods and mountain plant with four white bracts surrounding small greenish flower cluster.

There are many excellent field guides for amateurs that will include your geographic area.

E.M.S.

See also: CAMPING; FLOWER CARE; HIKING; OUTDOOR LIFE.

WHERE TO FIND IT

If you have any questions, or desire assistance in identifying wild flowers, write to The New York Botanical Garden, Bronx, N. Y. 10458.

The Camper's Guide to Animal Intruders

No matter how cute they look, those campground prowlers are still wild animals. Enjoy them, but treat them with respect. A raccoon can give you a nasty bite and "Smokey the Bear" can tear your arm off without even half trying

WHETHER YOU'VE CAMPED in a private, public or wilderness campground, it's a good bet that you've encountered a few varieties of wildlife that have wandered into camp out of curiosity or in search of a hand-out. The usual visitors are raccoons, porcupines, skunks and bears. By following a few simple precautions, wild visitors can be the most enjoyable aspect of the trip.

One of the more common camp visitors is the raccoon. These ringtail bandits aren't exactly the shyest creatures, as any camper who has heard them banging and rattling garbage cans during the night can readily testify. A family of raccoons are perfectly willing to stay around an area where the garbage disposals offer the chance of a midnight snack, though most campgrounds have regular garbage pick-up.

The raccoon usually isn't so bold as to enter a tent or to sit by a picnic table begging for scraps, but it is frequently heard scuffling about the fireplace or eating area during its nocturnal wanderings. Though most camp visitors of the animal kingdom amble about during the night, it's not unusual to encounter them during the day.

The skunk is probably the most unwanted character in the animal world. The possibilities of it leaving its legendary odor puts it on the bottom of the camper's popularity list. Unfortunately, skunks aren't aware of this and are occasional visitors in camp. For the average camper, it may be a rather nerve-racking and only too memorable experience.

Leaving food within smelling and reaching distance of animals is an open invitation for a dinner date with a wild guest.

When in porcupine territory, you should not only keep food in a safe place, but also anything that may be damaged by chewing. Porky is a common camp visitor. He loves to chew on things, and not necessarily food.

winches: see boating

If you use caution, wild visitors can be the most enjoyable part of your camping trip.

Equipment items ranging from axe handles, canoe paddles, or pack straps have all fallen victim to his habit of gnawing. Why? Porky has a natural craving for salt. Anything that has come in contact with human perspiration retains traces of salt that attract the animal. It's a wise idea to place anything that the porcupine can chew, safely out of its reach.

Of all the species of our native wildlife, campers probably dread the roving black bear the most. The bruin is common in many parts of the country and occupies the same range as many of our national and state parks.

Our western parks, especially Yellowstone National Park, must often cope with bears that have become panhandlers, constantly intent on mooching food from campers and other travelers. Tourists are even tossing scraps from their cars despite the pleading of park officials not to do so.

The well-known Yellowstone bruins are intelligent enough to seek food in the camping areas. In an attempt to foil them, rangers once installed sunken garbage cans with flip-up lids. The bears soon caught on. They became amazingly adept at pressing the lever down with their paw to flip the can open. Campers described the ensuing night-time noises as similar to clanging cymbals.

As if the problem of bears' lack of man-fear were not serious enough, man has lost his fear of bears. Tourists think the bears are cute, harmless and completely tame. TV commercials and cartoons have pictured the bear as a buffoon, though able to distinguish right from wrong. It's an easy impression to get.

People have been known to tempt the creatures with food to get them to beg. Some tourists have actually posed their small children next to the bears for a snapshot to show the folks back home. This is dangerous business.

A park ranger at Yellowstone once said, "People seem to see the bears in the Smokey or Yogi Bear image. We can't convince tourists that the animal is wild and has the potential to rip an arm off of a person or worse."

Does the message here come through loud and clear?

Any form of wildlife, large or small, that wanders into camp is wild. It has wild instincts and habits. Though it may appear tame and cute, it still should be treated, not necessarily with fear, but with respect and caution. An animal you tease by offering it food and then taking it away is potential trouble. A bear, for instance, may respond

to this idiocy by attempting to seize the food whether your arm or hand is connected with it or not. The bear merely follows its instincts.

Bears can be a problem if your food isn't stored out of reach. If a bear is in the vicinity and it seems to be looking over your camp, make lots of noise to let him know you're around. This has worked well to keep them away.

If you're accustomed to taking the family pooch along on camping trips, keep it securely leashed. Practically all camping areas require this. There is always the danger of your dog tangling with wildlife in the vicinity.

A match between a raccoon and a dog, especially a small dog, will usually see the raccoon come out on top. Raccoons are rough customers when provoked by another animal. With their strong, sharp teeth and claws as standard equipment, they've

Squirrels are often described as cute and delightful by campers, until one discovers all that remains of the evening's food supply is a ripped box.

This Yellowstone grizzly bear has the potential to rip your arm off.

been known to whip large dogs rather thoroughly and bloodily.

If your dog happens to pick a fight with a skunk, it's rather doubtful that the pooch will make the same mistake twice. The lingering odor of a skunk-sprayed dog isn't pleasant for you or your unfortunate pet.

The slow, lumbering porcupine isn't afraid of any canine. Porky will simply roll himself into a ball, wait until the dog gets too close, then swash his tail and leave behind a mass of quills protruding from the dog's nose and mouth. It's not pleasant to see your pet in pain. The dog must be treated promptly. If no vet is around, yank out the quills with pliers.

If you have your dog with you while camping in bear country, be particularly careful about keeping it leashed. Bears, if provoked, will make hash out of a house pet. They are very dangerous even to hard-

Lumbering clown of the woodlands, the porcupine is most often seen feeding high in trees. Some favorite desserts include axe handles and canoe paddles.

This masked visitor of the night, the raccoon, is a master thief when it comes to stealing foods such as bacon. Sleep near an old boot that you can throw.

Shy of humans except when feeding in garbage dumps near campgrounds, black bears offer snapshot opportunities to campers who wisely stay in cars.

ened, experienced trail hounds. So put your dog on a long leash or walk it frequently. He will be healthier and you'll be happier.

The amount of wildlife you encounter depends, of course, on the camping area and season. During the peak vacation season when campgrounds become heavily populated, most types of animals avoid the area, especially during the day.

As night approaches and campground activity slows down, animals may venture in or near the tents. For instance, the raccoon, if accustomed to humans' camp procedures, will often sneak in to check the picnic table or fireplace leftovers.

Towards autumn, when most campgrounds are largely empty, the animals get bolder. A ranger in a Wisconsin state park says that porcupines, skunks and bears then enter the grounds more frequently. They seem to know when the camping activity begins to taper off.

An occasional visit by wildlife is one of the pleasures of camping. Our national and state parks were designed to protect the wildlife and scenery in its natural state. If "pesky" species of wildlife were removed from the territory around the camping area, a wonderful element would be lost. For many, the opportunity to see wildlife is the primary reason for going camping.

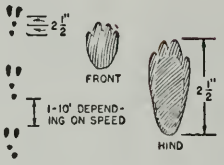
If a curious raccoon or skunk happens to drop in, don't chase it away if it's not damaging anything. It's much more enjoyable to see it in the wild than in a barred cage at the zoo. R.L.

See also: CAMPING; FIRST AID; HIKING; PEST CONTROL; SNAKES.

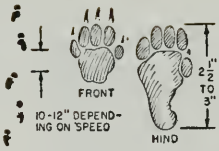
Recognizing Animal Tracks

How to read the tracks that animals leave in the snow, wet ground or heavy dust

Gray squirrel. This lively fellow ranges from southern Canada and Nova Scotia all through the eastern and midwest United States down to Florida—in farms, towns, cities and suburbs. Note that, like the rabbit, its hind feet show up ahead of the smaller front ones.

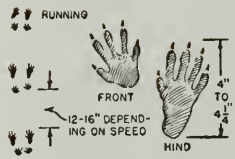


Cottontail rabbit. When on the run, this common small game animal doubles up so completely that its hind feet register ahead of the front ones. After a daytime snowfall (one or two inches is ideal for reading tracks) look for cottontails to do a lot of traveling that night.



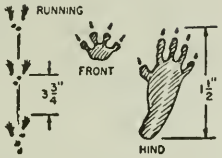
Skunk. Sometimes (but never too affectionately) called "polecat," this fellow leaves a snow print which usually shows the nails of its front feet (developed for digging). The hind foot of the common striped skunk rarely shows nails. You'll find this fellow in almost every type of terrain except very dense woods or extremely dry desert country areas.

Mink. A member of the weasel family, this semi-aquatic furbearer with the expensive coat likes to live near a stream, pond or river well stocked with its favorite food—fish. Note: When jumping quickly through the snow, it will show an occasional three-print track similar to that pictured here. In heavy snow, its tail marks may show.



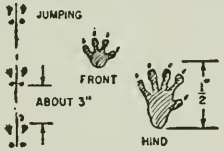
Raccoon. Its front feet (used like hands) have very long, slender toes, and the larger hind feet make a characteristic flat impression on snow or mud. Look for its tracks in woods, around ponds, along streams and in fields when snow is on the ground in sufficient quantity.

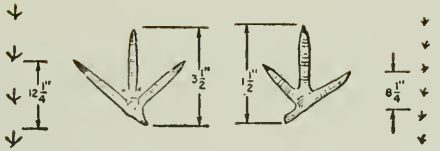
Red fox. The pads on fox tracks are smaller than those on a dog, and they are surrounded by fur which usually shows up in snow prints. Fox tracks also fall in a fairly straight line, with a blurred mark from their tail between the tracks—a distinctive fox feature.



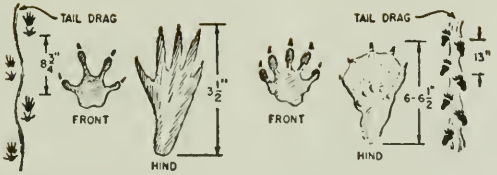
▲ *Common rat. Location of the track, the way the animal walks flat-footed, and the weaving mark of its slim tail are three outstanding features to keep in mind when identifying the trail of a house rat. Spacing may vary but this point is not important if you remember that the hind foot of a rat measures about 1½ inches in length. When walking, prints may be just an inch or two apart. When running, distance between prints may vary from 5 to 7 and more inches. When either walking or running the rat leaves a very slender tail mark in the snow.*

▼ *Deer mouse. Although the common chipmunk hibernates and therefore its trails are rarely seen in the snow, the attractive little deer or white-footed mouse is active all winter. It's found all over North America, from the Arctic to Florida, nesting in logs, trees and other hideouts. Colored a warm tan or gray above, it's the most attractive member of the mouse family. You'll see the delicate records of its snow tracks all winter. The deer mouse, being a climber, has paired foot tracks. Its hind foot leaves a track less than a half inch in length. Space between sets of tracks may be 3 inches, on the average.*

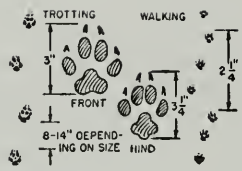




▲ *Pheasant, left. You'll find this fellow's tracks on farms, marshes, sloughs, woods and even in barnyards and city suburbs when the winter is a rough one. The large size of its track (compared to such birds as quails) and the fact that the middle toe points in a straight line along the trail makes it easy to identify. Quail, right. Note the characteristic angle of the hind toe.*

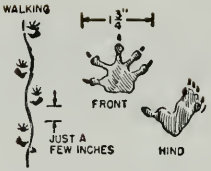


▲ *Muskrat, left. Around lakes, farm ponds and sloughs, you can recognize the prints of this aquatic rambler by the weaving line left between the prints in soft mud or snow, made by the thin edge of the rat's trail. Beaver, right. The large footprint and wide trail of its tail identify this fellow. Although all toes have claws, claw on second toe of hind foot is split and seldom registers in the tracking pattern.*

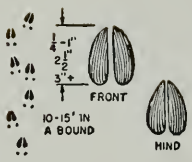


Dog. Compared to fox prints, those of a dog are usually larger and relatively free of fur between the pads. The dog's foot is also softer, and thus tends to spread out more in the snow, whereas the longer, narrower fox's footprint shows a more cleancut register. As the drawings show, a dog also does not walk in as straight a line as either the fox or the coyote.

House cat, left, and bob-cat, right. Although somewhat similar, the prints of the house cat's wild cousin, the bob-cat, are larger as noted. Both leave much the same walking pattern, but the spacing between paw prints is greater for the bob-cat. Also note the extra center point on the heel and palm of rear pad of the bob-cat's print.



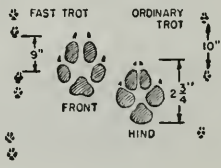
Opossum. Looking like the animal walks on its hands, this wandering trail, outward pointing toes and odd "thumblike" hind footprint of this rather slow-moving fur bearer make it easy to spot. It also may drag its tail, leaving a mark like that shown between the foot prints in snow (but not as narrow a mark as the muskrat). Opossums thrive in and close to large cities where there are wooded areas available.



White-tailed deer. Found in forested areas from coast to coast, this game animal thrives even in many farming areas. Its print size may range from one-quarter to one inch in length for a fawn, up to about 2 1/2 inches for a doe or female deer and 3 inches for a full-grown buck. Distance between tracks of a walking deer is only a few feet but a bounding deer at full speed can cover 10-15 feet in one bound.

Black bear. Because he hibernates you'll have to catch this fellow's tracks during the early snows, or in the mud after the spring rains have softened things up around the shore of a lake or along a river. Note the nail tracks, which show up when the snow or mud is good for tracking.

Coyote. Sometimes confused with the track of a big red fox, the coyote track can be distinguished by the fact that the pads are not surrounded by fur and they do not have the tail brush mark as the fox frequently does. The coyote's front foot track is usually more elongated than that of the hind foot. Note that this animal places its feet in a pretty straight line, whether traveling fast or slow. Track size is between that of a wolf and fox and spacing is about like that of a medium-sized dog.



How to Make Casts of Animal Tracks

This fascinating hobby is inexpensive and it can produce interesting plaques for your wall or to use as gifts

WANT AN EASY-TO-DO, inexpensive hobby that will provide unique trophies? Try game bird and animal track collecting. Exact duplicates of tracks, just as you find them in the wild, can be cast in plaster and used for instruction purposes, or the casts can be colored and used as trophies to hang on your walls; you can re-cast them for gifts as ornamental paper weights, ashtrays or pin trays.

Just look underfoot outdoors and you'll realize how many wild creatures leave their footprints along the stream and lake shore, in the woods, along country roads, in meadows and plowed fields. Everywhere and in all seasons. Even the desert, which many persons believe to be almost devoid of life, has its own nocturnally made footprints.

Look along the muddy or sandy shores of ponds, streams and lakes for the tracks of raccoon, mink, beaver, shrews, white-footed or deer mice, jumping mice and many species of birds. Birds that commonly haunt the waterways are the plovers, herons, sandpipers, and the perching birds that come for a drink.

The woods, dusty or wet country roads, and trails and fields yield the footprints of foxes, coyotes, woodchucks, rabbits, porcupines, grouse, quail and many smaller birds. Look in foothill and mountain country for deer, bob-cat, moose, sheep and many small furbearers and birds. Deserts and sandhills will furnish tracks of antelope, fox, badger, jack rabbit, prairie dog, kangaroo rat, ground squirrel, road runners, vultures and ravens. Park areas in bear country will have good bear tracks on nature trails, around garbage pails or near garbage dumps.

Periods of damp weather, when the soil is easily impressed, or periods of drought, when the soil is very dry and powdery, yield the best defined tracks.

Supplies for lifting wildlife tracks are few and simple. Here's all you need to start your collection of animal and bird tracks:

1. A few pounds of plaster of Paris (be sure it's fresh) or dental plaster for finer detail.
2. A wooden paddle about the size of a tongue depression.
3. A few strips of cardboard about three inches wide and a foot long.
4. A few paper clips.
5. A bottle of water.
6. A few feet of cord (trot line staging is good).
7. An old coffee can for mixing water and plaster.

You may find that plaster of Paris and dental plaster are tricky to work with. Give it a try before going afield. Mix up a small amount and experiment with some easily available tracks such as those of a dog or a cat to get the feel of handling plaster. After you see how plaster behaves when mixed with water, you should have no difficulty in using it to lift tracks.

If the track you want is under water, use a form of tin strips and use thicker plaster than you would for a track on land. Make a tube of heavy kraft or waxed paper similar to a cake decorator's funnel to force the plaster into the form.

Two or three days after its taking, the cast can be washed with a thin solution of plaster, brushed with Indian red or burnt umber, or coated with red or white shellac. Should you want to preserve complete tracks of the smaller animals, connect the cast with small sticks.

Duplicates of the track as it originally appeared are also easily made. Coat the cast with shellac, let dry several hours, and then brush with lard or petroleum jelly. Place a form around the cast and pour about half an inch to an inch of plaster over the mold. If you'd like a colored track, add Indian red or burnt umber to the water before mixing it with the dry plaster. When the plaster has set, remove it from the mold and there's your finished track.

The potential variety of your collection is limited only by your ability to discover the originals when you are afield. Better start looking now; they're there. T.G.

See also: HIKING; SHELLS; WILD FLOWERS.

Casting an animal track is easy. Simply mix a batch of plaster of Paris to the consistency of mucilage—too thick and it won't fill the track completely, too thin and it will wash out detail —and pour it gently on the track. Dam around the track was made of a strip of cardboard. In very wet ground, use a strip cut from a tin can or a large plastic container.

Let the plaster set for 15 to 30 minutes, then lift the casting and you have the impression of the animal's paw. To make a positive, coat casting with petroleum jelly thoroughly, surround it with a dam of paper and pour on the plaster. When it hardens, you'll have a duplicate of what was impressed in the ground.